Section F: Property Types and Registration Requirements

F 1: INTRODUCTION

Section F provides a roster and descriptions of the historic Property Types common to uranium mining in western Montrose and San Miguel counties. The Property Types are categorized according to prospecting, mining, ore treatment, and associated settlement. The objective is to bring order and standardization to cultural resource work and historic preservation, and to provide information for sound resource interpretation. To meet this goal, each Property Type features a list and description of common archaeological, engineering, and architectural features. The researcher should review the description of mining methods and equipment in Section E for a better understanding of some of the Property Types.

F 1.1: Period of Significance Defined

The timeframe to which a resource's physical remains date is usually a key consideration for eligibility. Some time periods were important and others were not, and the important ones are known as Periods of Significance. Uranium mining had six distinct Periods of Significance, summarized in Table F.1 and discussed in detail in Section E. A Period of Significance marks a timeframe that was rich with important events, trends, and contributions. Resources that date to a given Period of Significance may be eligible if they were allied with the Period's important events and trends. Other resources may exemplify a specific type of prospect, mine, or mill that played an important role during the Period. In any case, the resource must retain physical integrity relative to the Period. If a resource dates to a timeframe that was unimportant, it was probably not associated with significant events and trends.

Table F 1.1: Uranium Mining Industry Periods of Significance

Period of Significance	Timeframe	Principal Theme
First	1898-1905	First uranium mining and milling, and beginning of industry. Uranium produced for its radium content.
Second	1906-1922	First vanadium mining and milling. Uranium and vanadium boom. Vanadium produced as steel alloy, uranium for its radium content.
Third	1935-1940	Revival of vanadium mining.
Fourth	1941-1945	Vanadium produced as weapons-grade steel alloy. Uranium secretly produced for Manhattan Project nuclear program.
Fifth	1946-1963	Vanadium produced for weapons and consumer goods. Uranium produced for Cold War nuclear weapons programs.
Sixth	1974-1980	Vanadium produced for consumer goods. Uranium produced for nuclear power.

Figure F 1.1: The graph illustrates uranium production from 1952 to 1982. The two production peaks coincide with the Cold War boom of the 1950s (fifth Period of Significance) and the Nuclear Power boom of the late 1970s (sixth Period of Significance). Source: U.S. Uranium Mining, 1984:31.

F 1.2: Applying NRHP Criterion G to Resources Less than 50 Years Old

> *Criterion G:* The resource must have achieved significance within the last 50 years and be of exceptional importance.

When researchers evaluate the significance of uranium mine sites, they must follow the same general guidelines that apply to other types of mining resources. First, eligible uranium mining resources must possess physical integrity relative to one of the six Periods of Significance experienced by the uranium mining industry. Second, the researcher should determine whether the uranium mining site meets one of the four NRHP Criteria traditionally applied to historic resources. To qualify for Criteria A through D, the NRHP requires a resource to be at least 50 years of age, which is the official definition of the term *historic*. National Park Service historians, however, acknowledged that some types of resources younger than the 50 year threshold are worthy of listing on the NRHP and drafted Criterion Consideration G for such cases. In sum, Criterion G was designed for "a property achieving significance within the past 50 years if it is of exceptional importance."[1] Of all the specific types of mining resources, uranium mines are among the few that can clearly qualify for eligibility under Criterion G. For this reason, a special discussion is provided here.

In National Register Bulletin 42, National Park Service mining historians Bruce Noble and Robert Spude specifically discuss how Criterion G applies to uranium mining resources. Noble and Spude state:

> If sufficient scholarly documentation has been produced to demonstrate that particular uranium mines played exceptionally important roles in the development of the nation's nuclear capabilities, these mines may be eligible for listing in the National Register even through they are less than 50 years old. Establishing exceptional importance will require that such mines be compared with other uranium mines having similar associations and qualities in order to identify the strongest candidates for National Register listing.[2]

It appears that enough uranium mining resources have been recorded on the Colorado Plateau since 1998, when Bulletin 42 was published, to form a comparative body for others in the region. This and the academic research that has been completed to date can help interpret the application of Criterion G to uranium mining resources in Montrose and San Miguel counties.

On a broad level, Criterion G should be reserved for those sites that date to one of the uranium mining industry's last two Periods of Significance, which occurred within the last 50 years (summarized in Table F.1 and discussed in detail in Section E). In general, mining resources that date to one of these two Periods tend to be associated with and contributed to trends that were of national and worldwide importance. During the first of the recent Periods, which spanned 1946 to 1963, the mining industry produced uranium to fulfill the nation's military nuclear capabilities. By 2013, the entire Period will be greater than 50 years old, Criterion G will no longer apply, and associated mine sites can then be evaluated under NRHP Criteria A through D. The second of the Periods spans 1974 to 1980, and during this time, the

[1] Noble and Spude, 1992:18.
[2] Noble and Spude, 1998:18.

uranium mining industry responded to the nation's energy-related nuclear capabilities. The Federal Government no longer purchased uranium for military uses and instead promoted nuclear power, which became a significant energy source during the 1970s.

On a resource-specific level, some types of uranium resources are more likely than others to be eligible under Criterion G. Large mines are likely candidates because they yielded high volumes of ore and hence rendered significant contributions of uranium to nuclear weapons and power programs. Small mines operated by lessees also may be likely because of their importance to the uranium industry. While each small mine generated relatively minor amounts of ore, they constituted a greater whole that out-produced the large mines at times. According to archival sources and a survey of Colorado Mine Inspectors' Reports, the small mines not only outnumbered the large operations in a 10 to 1 ratio, but also they generated at least half of the ore.[3]

Additional types of uranium industry resources besides mines may be eligible under Criterion G. Mills were extremely important because they converted the crude ore produced by the mines into yellowcake, which the Atomic Energy Commission refined into weapons- and fuel-grade uranium. Milling was an essential aspect of meeting the nation's military and power nuclear capabilities. Settlements directly associated with and historically dependent on mines and mills may also be eligible through their association with the uranium mining industry. The settlements were important because they supported the workforce on which the uranium industry depended.

Uranium mining resources less than 50 years old must meet a requirement in addition to exceptional importance. They must retain either archaeological, engineering, or architectural integrity relative to the Period of Significance during which they were active. The physical remains should clearly represent the operation, the resource type, and the timeframe.

The last stipulation for recommending a uranium mining resource eligible under Criterion G requires the researcher to clearly demonstrate the site's importance. The researcher should explain the site's history, the significance of the resource type, and how it relates to the trends that were important during the Period of Significance.

[3] *Mesa Miracle*, 1952:29;"Mesa, Montrose, and San Miguel Counties" 1952; Perry, 1981:120; Ringholz, 1989:43; "Uranium Activity on the Colorado Plateau" 1952; "Uranium Mining Activity" 1953.

F 2: PROPERTY TYPE: PROSPECT

A prospect is a manifestation of an effort to locate ore in economic volumes. By definition, a prospect yielded no significant production, or it would qualify as a mine. Prospects ranged in scale from shallow pits to underground operations, and the absence of ore storage facilities, minimal property development, inexpensive and portable equipment, and the investment of little capital often are hallmarks of such operations. While most prospects were simple and shallow, some were deep and fairly advanced. Deep prospect shafts sunk during the 1900s and 1910s usually required formal engineering, and most of the prospects post-dating the 1930s, regardless of type, were often developed with portable equipment such as rockdrills and air compressors.

Today's prospect resources fall into four subtypes, which include prospect complexes, adits, shafts, and drill-hole patterns. Categorically, most resources will possess archaeological integrity only and feature no engineering or architectural aspects. The reason is that prospects were austere operations and had few if any structures or buildings, and those that may have been present were almost always dismantled. Prospects also usually offer only impoverished artifact assemblages because they were occupied for brief periods of time.

F 2.1: Prospect Subtypes

Prospect Complex: When prospectors attempted to locate mineral formations underlying the soil, they often excavated groups of pits and trenches to expose bedrock. If the prospectors uncovered a promising lead, they drove adits and shafts to explore and sample the formation at depth. Collectively, the groups of pits, trenches, adits, and shafts can be termed prospect complexes. Pits and trenches will be surfacial, shafts and adits should be shallow, and the sum represents mineral sampling and a search for ore. It should be noted, however, that some prospectors drove shallow adits and shafts merely to fulfill assessment obligations to retain title to their mining claims. Experienced prospectors often followed an organized, strategic pattern when excavating their workings, which may become apparent when the features of a prospect complex are mapped.

If a prospector invested an appreciable amount of time in a complex, which was necessary to drive an adit or a shaft, he usually constructed a few infrastructure components to support his work. One of the most common was a field forge where the prospector maintained his tools and fabricated basic hardware. Field forges were usually in the open and made with dry-laid rock masonry or small logs. Another was a residence, often either a simple cabin or wall tent, unless a settlement lay nearby. Shafts required a hoist, and prospectors favored hand windlasses for their portability and low cost. A hand windlass was basically a wooden spool with a crank handle set in a frame over the shaft collar. Adits required wheelbarrows or ore cars to haul rock out. Because prospectors usually removed their equipment when they abandoned a site, archaeological features and excavations tend to represent prospect complexes.

Prospect Shaft: This resource type is single, unproductive, and simple shaft operation with a waste rock dump of limited volume. Prospect shafts, either vertical or inclined entries underground, often featured surface plants equipped with a hoisting system and a shop area. Hoisting systems were simple and, from the 1900s into the 1930s, ranged from manually operated windlasses to small gasoline units, discussed below. By the 1950s, prospect outfits used stationary gasoline hoists or winches on trucks. The surface plant components were usually clustered around the shaft and, by definition, prospect shafts lacked evidence of ore storage or processing facilities.

As a resource type, prospect shafts tend to be common, while examples retaining high degrees of archaeological, engineering, or architectural integrity are uncommon and often important. Intact shaft collars are important, as are machinery and structures.

Prospect Adit: When prospectors discovered a carnotite deposit of promise, they usually drove an adit to explore and sample it at depth. An adit was a horizontal entry underground usually 3 by 6 feet or less in-the-clear. Most adits lacked surface facilities, and prospectors usually used wheelbarrows to haul waste rock out. By the 1950s, prospectors bored blast-holes with rockdrills and parked portable compressors near the adit portals to power the drills. Artifacts such as motor oil cans, air filters, and engine parts often denote where the compressor was located.

If the adit failed to encounter ore in economical volumes, the outfit usually abandoned the site and removed all items of value. Given this, archaeological features and artifacts tend to represent prospect adit sites today. In some cases, the adit portals collapsed, leaving areas of subsidence that can appear similar to lengthy trenches. For a site to be defined as an adit, the volume of waste rock should exceed the area of subsidence.

Bore Hole Pattern: As early as the 1910s, mining companies bored sample-holes in search of ore. They commonly used rockdrills, and the holes tended to be less than 2 inches in diameter. By the 1950s, drilling was the conventional prospecting method, and drills of this era created holes that ranged from 2 to 6 inches in diameter. When soil overlay bedrock, workers usually shoveled off the overburden prior to drilling, leaving pits. To prevent the soil from slumping back into the bore-holes, the workers inserted tarpaper or sheet-iron casings, many of which still remain. If an assemblage of holes conforms to a grid, which should be apparent when mapped, the group was probably the product of a survey for ore. If the assemblage features tightly spaced holes, the group was probably bored to define a known ore body. Because sample-drilling required land preparation and vehicle access, bulldozed roads, clearings, and piles of debris are features of this resource type.

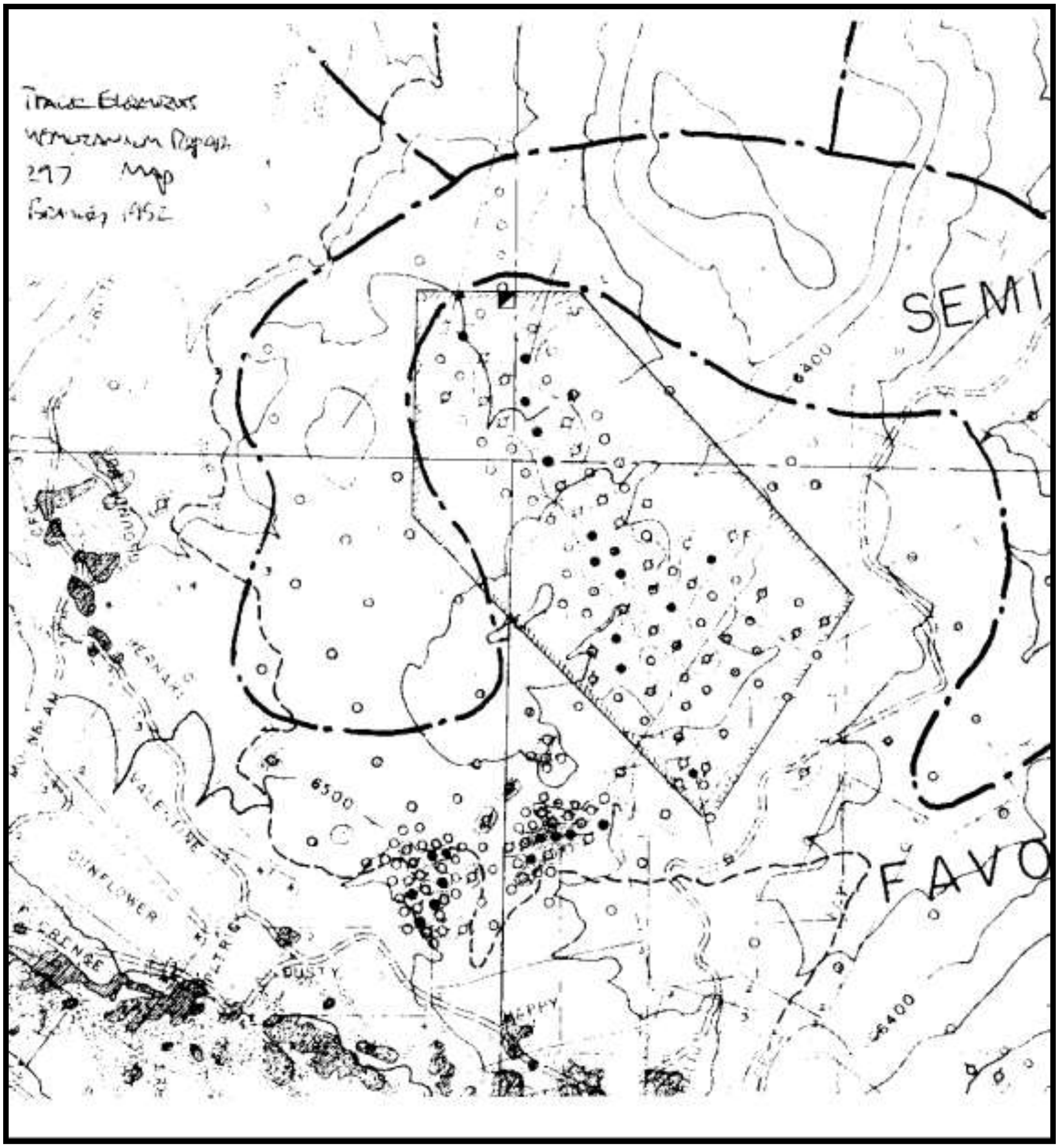


Figure F 2.1: The 1952 map illustrates several bore-hole patterns drilled northwest of Long Park. The broad grid at left-center was a survey for ore, and nothing was found. The distinct grid at center was drilled to define the Hidden Basin Mine's ore bed, and the two clusters at lower center were drilled to define the Republican Mine's ore formations. Source: Bradley, 1952.

Features Common to Prospect Resources

Bore-Hole: Bore-holes created with hand-held rockdrills were usually circular and less than 2 inches in diameter. Holes bored by diamond drills and rockdrills mounted on trucks and trailers tended to range from 2 to 4 inches in diameter. Holes bored by churn drills and rotary rigs were 4 to 6 inches in diameter and at the bottoms of shallow pits. Bore-holes may feature tarpaper, steel, or plastic casings. Wood blocks to level the drill-rig may lie around the hole.

Claim Marker: Prospectors erected claim markers at the corners of their claims, which were usually 150 by 1,500 feet in area. Markers ranged from cairns to blazes on trees to up-ended boulders. When a surveyor mapped and registered a claim, he usually etched the mineral survey number into a corner rock.

Claim Stake: A claim stake was the universally recognized form of claim marker. Claim stakes were usually 4x4 posts 4 feet high, although prospectors often substituted logs.

Compressor Station: By the 1930s, miners used rockdrills to bore blast-holes, and these machines were powered by compressed air. Most prospect outfits brought trailer-mounted compressors to their sites and parked them on flat areas near the point of work. Miners then plumbed the air into the adit or shaft via heavy, rubber/fiber hoses. Workers generated motor oil and antifreeze cans, air and oil filters, and engine parts when they maintained their compressors, and collections of these usually define a compressor station.

Drill Pad: Prior to boring a sample hole, workers bulldozed a drill pad on which to park the drill-rig.

Forge Remnant: Can manifest as a mound of gravel and rocks or the remnants of a gravel-filled wood box, usually impregnated with coal and forge clinker. When coal burned at high temperatures, it left a scorious, dark residue known as *clinker*.

Headframe: A frame made of timber or logs that stood over a shaft. Power hoisting systems usually employed *two-post gallows* headframes that consisted of two posts on timber footers, backbraces that supported the posts, and cross-members at top. The cross-members featured a large pulley known as a *sheave* that guided the hoist cable into the shaft. Headframes associated with prospect shafts were less than 25 feet high.[4]

Headframe Ruin: The collapsed remnants of a headframe.

Headframe Foundation: Headframe foundations usually manifest as parallel timbers that flank a shaft and extend toward the area where a hoist was located.

[4] Twitty, 2002:177.

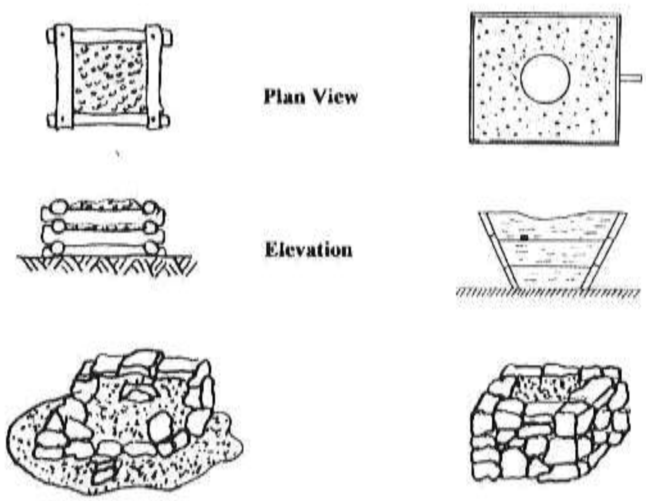


Figure F 2.2: Above are examples of the common forges used in mine shops. At upper left is a gravel-filled log forge, at right is a wood box forge, and at lower right is a dry-laid rock forge. Over time, rock forges decay and collapse, and manifest as the remnant at lower left. Source: Author.

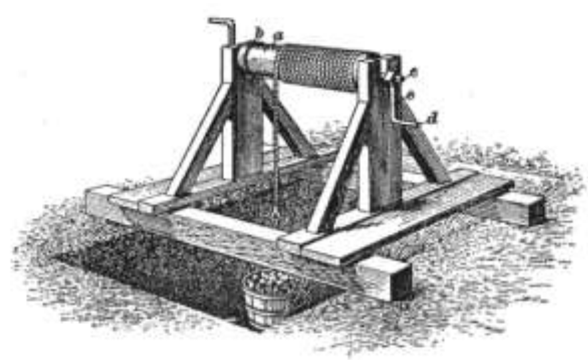


Figure F 2.3: Prior to the 1940s, nearly all prospect shafts less than 100 feet deep were equipped with hand windlasses because they were simple, inexpensive, and portable. Source: Twitty, 2002:145.

Hoist: Almost all shaft operations required hoists to raise rock out of the underground workings. While windlasses are versions of hoists, the term used here refers to mechanical types. The hoist's basic form remained fairly constant between the 1900s and 1950s, and most changes involved different sources of power. Between the 1900s and 1910s, steam and petroleum proved popular for uranium mining. As a general rule, existing hoists are rare and important engineering features.

The *single-drum steam hoist* was the most common type employed between the 1900s and 1910s. Single-drum steam hoists consisted of a cable drum flanked by two steam cylinders, and a braking apparatus, all assembled on a common cast iron bedplate. The steam cylinders powered the cable drum through a set of reduction gears, and the hoist operator controlled the machine via levers and foot pedals at the rear. Hoists less than 6 by 6 feet in area were intended for deep exploration, and larger units were intended for light to moderate production.

Between around 1900 and the 1930s, mining outfits in remote areas employed *gasoline hoists*. Factory-made models featured a large cable drum and reduction gears assembled on a tall cast iron bedplate. A single-cylinder gasoline engine was usually on the bedplate's rear, and the controls were either on the side or at the rear. The engine was distinct and consisted of a large, horizontal cylinder, dual flywheels, an exhaust pipe, and fine machine linkages. Between the 1920s and 1940s, some prospect outfits employed custom-built gasoline models that combined obsolete steam hoists with automobile engines.

Hoist Foundation: Nearly all mechanical hoists were anchored to foundations to keep them in place, and a foundation's footprint can reflect the type of hoist. Foundations are common at prospect shaft sites and can be found aligned with and at least 20 feet from the shaft. Because of their ease of construction and low cost, prospectors usually assembled hoist foundations with timbers, and occasionally with stone or concrete. Timber foundations decay and become buried over time, and they often manifest today as rectangular groups of four to six anchor bolts projecting out of a hoist house platform.

Hoist House: A structure that enclosed a hoist, the hoist's power source, and often a blacksmith shop. Hoist houses were usually located at least 20 feet away from the shaft.

Hoist House Platform: An earthen platform, usually graded with cut-and-fill methods, which supported a hoist house. The platform often features evidence of a hoist and a shop.

Hoist House Ruin: The collapsed remnants of a hoist house.

Mine Rail Line Remnant: When prospectors dismantled a track, they often left in-situ ties, impressions of ties, and sections of rails.

Pack Trail: A path less than 8 feet wide that provided access to prospect workings.

Figure F 2.4: Small gasoline and compressed air hoists were bolted to timber foundations such as this at the Hardrock No.1 Mine. The foundation is aligned with the shaft. Source: Author.

Figure F 2.5: Early prospect shafts were often vertical, framed with logs or lumber, and 4 by 6 feet in-the-clear or less. Source: Author.

<u>Prospect Adit:</u> A horizontal entry underground denoted by a waste rock dump. An adit tended to be short and less than 3 by 6 feet in-the-clear, while a tunnel was larger. When collapsed, adits appear as trenches.
<u>Prospect Pit:</u> A circular or ovoid excavation surrounded by a small volume of waste rock.
<u>Prospect Shaft:</u> A vertical or inclined opening underground. When intact, shafts tend to be rectangular and when collapsed, they manifest as circular areas of subsidence.

Prospect Trench: A linear excavation flanked by a small volume of waste rock.
Shop: A building that enclosed facilities where a worker fabricated and maintained tools and hardware. Simple shops usually featured a forge, a workbench, and possible hand-powered appliances such as a drill-press.
Shop Platform: An earthen platform that supported a blacksmith shop. Shop platforms may feature forge remnants and often possess artifacts such as forge-cut iron scraps, anthracite coal, and clinker, which is a scorious, ashy residue created by burning coal.
Shop Ruin: The collapsed remnants of a shop.
Waste Rock Dump: The waste material removed from underground workings.

F 2.2: Prospect Significance

The uranium and vanadium mining industry was founded on and a function of prospecting, and because economic ore could only be realized through prospecting, this activity was a cornerstone of the industry's history. Prospectors first began their exploration for carnotite along the Dolores River and Paradox Valley during the late 1890s, and sought roscoelite around Placerville around five years later. From that time through the 1970s, western Montrose and San Miguel counties saw several definable prospecting movements.

Prospecting can be divided into two general methods. The first and earliest was the traditional practice of finding ore through visual confirmation, sample assaying, and subsurface excavation. This played an important role during three Periods of Significance. Between 1898 and 1905 (first Period), prospectors applied traditional methods to find carnotite. Between 1906 and 1922 (second Period), prospectors sought both carnotite and roscoelite. Between 1947 and the mid-1950s (fifth Period), traditional prospecting was important to the Cold War uranium boom. Outside of these timeframes, sample drilling was the most important method of prospecting and largely rendered traditional prospecting obsolete (reviewed in Section E).

Sample drilling played an important role in finding ore beds during four different Periods of Significance. During the late 1910s (toward the end of the second Period), mining companies first found hidden, landlocked ore beds by sample drilling, and established a precedent for future exploration. From the latter half of the 1930s through the early 1960s (third, fourth, and fifth Periods), sample drilling was the principal means for discovering most of the region's economical ore bodies.

As an aspect of the uranium and vanadium mining industry, prospecting is associated with several important trends. First, prospecting was fundamental to the development and long-term success of the mining industry because the activity was the principal means for identifying economic ore formations. Second, prospecting was instrumental in the settlement and development of remote portions of western Montrose and San Miguel counties. Prospectors themselves were transient settlers, but their discoveries became the basis for longer-lasting populations. Third, prospecting contributed directly to the sciences of mineralogy and geology. The world had never seen carnotite until 1897, and the recognition of this rare mineral was an addition to mineralogy. Through their search for ore, prospectors and mining outfits began assembling a body of geological data regarding the distribution and occurrence of carnotite and roscoelite formations.

F 2.3: Prospect Registration Requirements

Prospect Complex: As a Property Subtype, prospect complexes tend to be common and few retain important characteristics or features. Given this, most will be ineligible for the NRHP, although several exceptions exist. Eligible resources must possess physical integrity relative to the exploration and discovery Period of Significance for a given mining district. Because prospect complexes possessed few structures, most of which were usually removed when the site was abandoned, the integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the prospect operation.

Not all seven aspects of historical integrity defined by the NRHP are likely to be relevant for prospect complexes. The most applicable aspects will probably be Setting, Feeling, and Association. The Setting around the resource, and the resource itself, must not have changed to a great degree from its Period of Significance, excepting the removal of structures and equipment. Usually, this requires a preserved natural landscape and environment. In terms of Feeling, the resource should convey the sense or perception of prospecting from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the prospect operation.

In addition to possessing integrity, prospect complexes must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as the events, trends, and themes important to a specific mining district.

Prospect complexes may be eligible under Criterion B provided that they retain integrity from the important person's period of occupation or participation. Because it is extremely difficult to directly attribute a given complex to an important person, few complexes will be eligible under Criterion B.

Most prospect complexes will also not be eligible under Criterion C because they manifest as random groups of pits, adits, and shafts. Such resources are common and offer few important characteristics and attributes. However, if the organization pattern is clearly evident, then the resource may be eligible under Criterion C as a representation of a discernable, organized, and planned effort. Prospect complexes many also be eligible under Criterion C if the resource possesses intact architectural or engineering features, since these were important aspects of prospecting and few survive today.

Few prospect complexes will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist. If a single group of workings appears to follow a pattern, then recording the surrounding groups may enhance the current understanding of the sampling methods that prospectors used. If the resource possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding prospectors' lifestyles and social structures, which is important because these were not heavily documented in the past.

Prospect Shaft: As a Property Subtype, prospect shafts tend to be common while examples retaining high degrees of archaeological, engineering, or architectural integrity are uncommon and may be important. For a prospect shaft site to be eligible, it must possess integrity relative to the host mining district's exploration and discovery Period of Significance. Because structures and equipment were usually removed when shafts were abandoned, the integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation.

Not all seven aspects of historical integrity defined by the NRHP are likely to be relevant for prospect shafts. The most applicable aspects will probably be Design, Setting, Feeling, and Association. For Design, the resource must represent engineering, organization, and operations from the relevant Period of Significance. A resource's overall feature assemblage and individual feature systems can represent Design, and most of these characteristics will be archaeological in nature. The Setting around the resource, and the resource itself, must not have changed to a great degree from its Period of Significance, which usually requires an intact natural environment. In terms of Feeling, the resource should convey the sense or perception of underground operations, both from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the historic operation.

In addition to possessing integrity, prospect shafts must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as events, trends, and themes important to the specific mining district.

Prospect shafts may be eligible under Criterion B provided that they retain integrity from the important person's period of occupation or participation. Because it is extremely difficult to directly attribute a given prospect shaft to an important person, few resources will be eligible under Criterion B.

Most prospect shafts will also not be eligible under Criterion C because they are common, offer few important characteristics and attributes, and usually possess integrity impaired by natural decay and modern disturbance. However, a resource may be eligible under Criterion C if it possesses intact structures and equipment, a high degree of integrity, or important engineering or architectural features. Important engineering and architectural features include intact buildings, structures, machinery, and shaft collars. Under Criterion C, the resource should represent deep prospecting, which was an important phase of mining.

Few prospect shafts will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist. Accessible and intact underground workings are important because few formal studies have been carried out regarding the underground work environment, engineering, equipment, and practices of drilling, blasting, and removing rock. Currently, historical documentation is the principal body of information that researchers rely on for studying the above aspects of prospect development. If the resource possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding prospectors' lifestyles and social structures, which is important because they were not heavily documented in the past.

Prospect Adit: As a Property Subtype, prospect adits tend to be common, while examples that retain high degrees of archaeological, engineering, or architectural integrity are uncommon and may be important. For a prospect adit to be eligible, it must possess integrity relative to the host mining district's exploration and discovery Period of Significance. Because structures and equipment were usually removed when adits were abandoned, the integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation.

Not all seven aspects of historical integrity defined by the NRHP are likely to be relevant for prospect adits. The most applicable will probably be Design, Setting, Feeling, and Association. For Design, the resource must represent engineering, organization, and operations from the relevant Period of Significance. A resource's overall feature assemblage and individual feature systems can represent Design, and most of these characteristics will be archaeological in nature. The Setting around the resource, and the resource itself, must not have changed to a great degree from its Period of Significance, which usually requires an intact natural environment. In terms of Feeling, the resource should convey the sense or perception of underground operations, both from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the historic operation.

In addition to possessing integrity, prospect adits must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as the events, trends, and themes important to the specific mining district.

Prospect adits may be eligible under Criterion B provided that they retain integrity from an important person's period of occupation or participation. Because it is extremely difficult to directly attribute a given prospect adit to an important person, few resources will be eligible under Criterion B.

Most prospect adits will also not be eligible under Criterion C because they are common, offer few important characteristics and attributes, and usually possess integrity impaired by natural decay and modern disturbance. However, a resource may be eligible under Criterion C if it possesses intact structures and equipment, a high degree of integrity, or important engineering or architectural features. Important engineering and architectural features include intact buildings, structures, machinery, and adit portals. Under Criterion C, the resource should represent deep prospecting, which was an important phase of mining.

Few prospect adits will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist. Accessible and intact underground workings are important because few formal studies have been carried out regarding the underground work environment, engineering, equipment, and practices of drilling, blasting, and removing rock. Currently, historical documentation is the principal body of information that researchers rely on for studying the above aspects of prospect development. If the resource possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding prospectors' lifestyles and social structures, which is important because they were not heavily documented in the past.

F 3: PROPERTY TYPE: MINE

Most mines were underground operations that produced ore, although western Montrose and San Miguel counties also featured open-cut mines. Between the 1900s and mid-1940s, organized companies usually operated the region's mines, regardless of size. By the late 1940s, however, parties of lessees worked the small and labor-intensive operations while companies ran the large properties. As a resource type, mines shared a few basic characteristics such as ore storage facilities, at least one structure, waste rock dumps greater than 125 by 125 feet in area, and roads for the transportation of materials and ore. The details of the different types of mines and their facilities are covered in Section E.

United States Department of the Interior
National Park Service
National Register of Historic Places
Continuation Sheet
Section number F Page 148

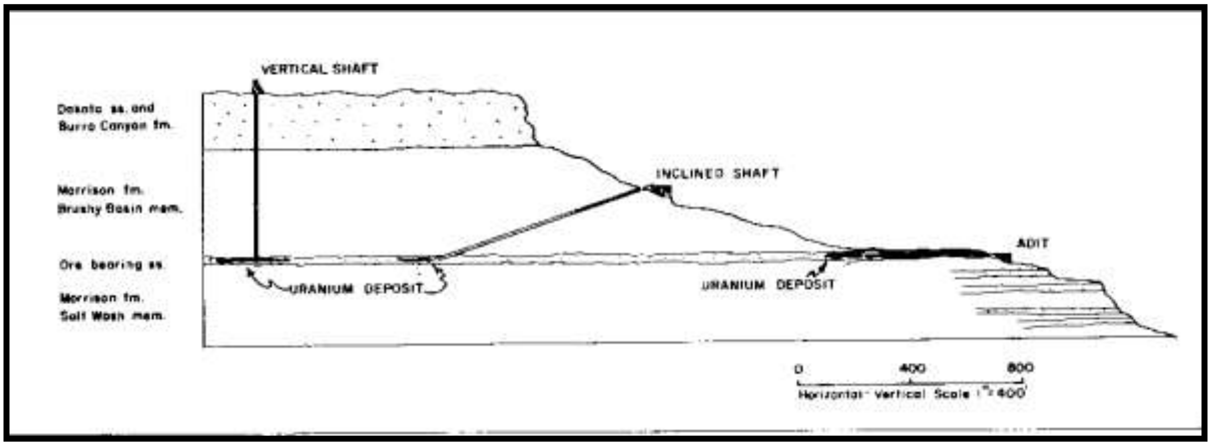


Figure F 3.1: The profile view illustrates three principal methods used to develop deep ore beds underneath sandstone cap rock. Inclined shafts and tunnels, referred to as an adit in the diagram, were the most common. Inclined tunnels were driven in addition to inclined shafts. Source: Del Rio, 1960:342.

F 3.1: Mine Subtypes

Rim Mine: In rim mines, outfits extracted carnotite from pockets either directly exposed in the cliffs and ledges of the region's mesas or embedded a short distance behind. In many cases, miners stoped, or removed, the ore directly from the sandstone formations as they encountered the material until the pockets were exhausted. Where the ore pockets were a short distance behind the cliffs, miners developed them through relatively short tunnels. Because of their shallow nature, rim mines required little infrastructure and therefore tended to be very simple and shallow.

As a resource type, rim mines usually manifest as groups of open stopes, short tunnels, and small waste rock dumps. The surface facilities were austere, and as a result, today's sites possess relatively few features. Typically, miners used wheelbarrows and ore cars to haul rock out of the workings, they built chutes and bins in which to store ore, bulldozed minor access roads, and graded parking areas for portable air compressors.

Rim mines can date to any of the uranium industry's time periods. Because carnotite pockets were directly exposed, they were the first types of ore bodies that prospectors discovered during the 1900s and 1910s. Through rim walking, prospectors found numerous, additional pockets during the intense uranium boom of the 1950s, and many of the known deposits were worked for low-grade ore as late as the 1970s. Most rim mines were the domain of lessees because the ore pockets were too small to directly engage large operations such USV, VCA, and Climax Uranium.

Figure F 3.2: The Rex No.38 Mine was a large and well-developed tunnel operation. The mine features a substantial tunnel, a heavy rail line on a trestle, and aspects of infrastructure such as the air compressor room at left. Like most tunnel mines, the Rex No.38 was driven to develop an ore bed deep within the same sandstone bed as the region's shallow rim mines. Source: Author.

Tunnel Mine: A tunnel mine was a productive operation based on a substantial horizontal entry usually at least 3 by 6 feet in-the-clear. Mining outfits drove tunnels to develop ore beds within around 1,000 feet of mesa or canyon rims. The outfits chose tunnels because they were easier and less costly to bore and operate than shafts. Usually, tunnels accessed ore beds discovered through sample drilling.

Tunnel mines ranged in size and complexity from shallow and simple to deep and complicated. The simple operations tended to be shallow and therefore had surface facilities, development characteristics, and equipment similar to rim mines. A principal difference was the size of a tunnel's waste rock dump, which was at least 125 by 125 feet in area. In contrast to small mines, the surface plants at the large operations often included permanent structures and machinery. Most substantial tunnel mines featured large waste rock dumps, compressed air systems, ventilation systems, and transportation based either on ore cars or, by the 1960s, trackless haulage vehicles. Ore bins were among the most common engineering structures, and they were usually sloped-floor or prefabricated types to accommodate substantial production. Frame buildings were also relatively common, although most large mines featured only several, at most. Of the types of frame buildings, compressor houses, shops, and change rooms where miners changed clothes were the most popular. Each type of building and feature system is discussed under general feature types below.

Because tunnels were driven to develop ore bodies discovered through drilling, today's sites postdate the late 1910s, when drilling was first employed. Further, most tunnel mines were developed during the 1950s uranium boom or later as a result of intensive drilling.

Inclined Tunnel Mine: An inclined tunnel mine was a productive operation based around a tunnel that descended underground at an angle between 10 and 25 degrees.[5] Mining companies drove inclined tunnels to develop landlocked ore beds discovered by exploratory drilling underneath sandstone cap-rock. Inclined tunnels were efficient for small ore bodies that were too far from a mesa rim for a horizontal a tunnel and yet too close to ground-surface to justify a shaft.

Most inclined tunnels required hoisting systems to pull ore cars to the surface, but the slight angle of ascent allowed the equipment to be very light in duty. Common types of hoists included small winches, air tuggers, and gasoline models, and they only had to be held in place with anchor pins and cables instead of formal foundations. Such equipment was easy to install and less costly than stationary gasoline and electric hoists. The embrace of trackless haulage vehicles during the 1960s negated the need for hoists. The reason was that trackless vehicles were designed to negotiate slight inclines.

In general, most inclined tunnel mines were small, shallow, and operated briefly. They usually had no more than one impermanent building, lacked stationary machinery, and possessed minimal surface facilities. The most important surface plant feature was a portable air compressor that allowed miners to use rockdrills underground Those mines with rail systems often included an ore bin, and operations that relied on heavy equipment and trackless haulage often had no ore storage structures at all. If the tunnel was lengthy, the operator may have bored a ventilation hole.

Because inclined tunnels were driven to develop ore bodies discovered through drilling, today's sites postdate the late 1910s, when drilling was first employed. Further, most mines were developed during the 1960s when trackless haulage vehicles became popular.

[5] Dare, et al, 1955:21.

Figure F 3.3: The inclined trestle and ore bin at the Margie Mine on Club Mesa are characteristic of inclined shaft sites. A hoist mounted on top of the bin winched an ore car up out of the shaft, over the trestle, and onto the bin, where a miner discharged the contents. Source: Author.

Inclined Shaft Mine: An inclined shaft descended at angle of 25 degrees or more, and mining outfits drove these openings to access landlocked ore beds discovered through sample drilling.[6] All inclined shafts required hoisting systems, and while specific types of equipment changed over time, the general template remained the same. Overall, the typical hoisting system consisted of little more than a mechanical hoist, a rail line in the shaft, and a landing near the hoist for ore cars winched to the surface. During the 1910s, mining outfits used either steam hoists or factory-made gasoline units anchored to formal foundations near the shaft collar. To guide the cable down into the shaft, some mines featured low-angle headframes while others merely had a roller on the rim of the shaft collar. At the shaft bottom, a miner coupled one or two ore cars onto the hoist cable, and

[6] Dare, et al, 1955:21.

on the surface, the hoist operator winched them up to the landing. A worker then uncoupled the cars and pushed them to their destinations.

Companies continued to use gasoline hoists during and after the 1940s, and if the mine had electricity, they opted for electric hoists. By this time, miners realized that elevating the hoist on a structure offered several benefits. First, a headframe was unnecessary because the cable was able to pass down the shaft unobstructed. Second, the hoist frame created vertical relief on relatively flat topography and became a landing for ore cars. Elevating the landing greatly eased the tasks of dumping waste rock and inputting carnotite into an ore bin.

Small operations were simple and had few surface facilities except for the hoisting system, an ore bin, and a portable air compressor. Large mines, in contrast, featured a substantial waste rock dump, a compressed air system, a ventilation system, an ore bin, an elevated hoist frame, and a hoist house. Additional frame buildings such as compressor houses, shops, and change rooms where miners changed clothes were also common. Each type of building and feature system is discussed under general feature types below.

Because inclined shafts were sunk to develop ore bodies discovered through drilling, today's sites postdate the late 1910s, when drilling was first employed. Further, most inclined shafts were developed during the 1950s Cold War uranium boom or later as a result of the intensive drilling campaigns.

Vertical Shaft Mine: A vertical shaft mine was a productive operation based around an entry that descended straight down into an ore bed. Because these ore beds were landlocked underneath layers of sandstone cap rock, they were almost all discovered through exploratory drilling. Vertical shafts required formal engineering and were much more costly to sink, engineer, and equip than all the other type of mines. They also offered a potential for the highest volumes of production.

All vertical shafts required hoisting systems, and while specific components changed over time, the general format remained the same. Overall, the typical hoisting system consisted of a headframe over the shaft, a hoisting vehicle, and a hoist in a hoist house. During the 1910s, mining outfits used either steam hoists or factory-made gasoline units anchored to formal foundations a short distance away from the shaft collar. Two-post gallows headframes were the most common because of their low cost and ease of construction. In terms of hoisting vehicles, companies used either free-swinging ore buckets or skips, which are discussed below under hoisting system feature types.

Companies continued to use gasoline hoists during and after the 1940s, and if the mine had electricity, then they opted for electric hoists. The hoist size depended on the depth of the shaft and the expected level of production, and hoists greater than 6 by 6 feet in area were intended to raise substantial tonnages of rock from deep shafts. By the 1940s, mining outfits found that the two-post gallows headframe was inadequate for production and instead erected four-post derricks, six-post derricks, and A-frames. Hoisting vehicles changed, as well, and the skip became the industry standard because of its efficiency.

Because vertical shaft mines tended to be substantial, their surface plants were larger and more complex than the other types of uranium operations. Most vertical shaft mines featured a voluminous waste rock dump, a compressed air system, a ventilation system, ore chutes, an ore bin, a hoist house, and a compressor house. Each type of building and feature system is discussed under general feature types below.

Because vertical shafts were sunk to develop ore bodies discovered through drilling, today's sites postdate the late 1910s, when drilling was first employed. Further, most vertical shafts were developed during the 1950s uranium boom or later as a result of intensive drilling campaigns.

Open-Cut Mine: An open-cut mine was an operation based around a surface excavation of substance. In rare instances, ore beds of substantial sizes cropped out directly in sandstone or were covered by thin veneers of soil and rock. Such conditions were similar to but grossly enlarged versions of the carnotite pockets associated with rim mines.

All a mining company had to do to develop the bed was blast away the overburden, establish a working area for equipment, and grade access roads for trucks. Prior to the 1950s Cold War uranium boom, mining companies worked open-cuts with methods similar to underground operations. Specifically, miners bored blast-holes with hand-held drills, removed the carnotite as they encountered it, and trundled the material in wheelbarrows or ore cars to a bin on the downslope edge of the cut. The miners used these same conveyances to eject waste rock over the edge, where it accumulated in the form of a dump.

Heavy equipment became widely available during the 1950s, and mining companies immediately embraced it for open-cut mining. Bulldozers and front-end loaders allowed workers to move far more rock and earth than was previously possible. With drill-rigs and wagon drills, workers bored larger and deeper blast-holes than they could have with hand-held models. Dump trucks and buggies replaced ore cars and wheelbarrows for moving ore and waste rock. Overall, the heavy equipment lowered operating costs and facilitated ore production in economies of scale. As a result, mining companies were able to pursue low grades of ore from underneath thick layers of overburden.

Mining companies considered open-cuts to be ideal because they were easy to develop and required minimal infrastructure, which translated into low operating costs. Prior to the 1950s, open-cut mines usually included a transportation system, an ore bin, and, if the operation was large, possibly a shop. After the 1950s, heavy equipment rendered even these facilities unnecessary. As surface operations, open-cuts lacked most of the facilities that were critical for underground mines such as hoisting and ventilation systems. Also, open-cuts usually needed no compressed air systems. Instead, workers were usually able to park portable compressors near their points of work and provide air to their drills via heavy hoses.

In general, the large ore beds developed through open-cuts and the small pockets developed as rim mines occurred together in the same geological conditions. Given this, open-cut mines usually included at least some shallow underground workings from pocket mining. For a historic resource to qualify as an open-cut mine, the underground workings should be minor and the surface excavation the dominant aspect.

Open-cut mines can date to any of the uranium industry's time periods. Surface pockets and beds were among the earliest ore formations to be discovered, and as a result, many were brought into production during the 1900s and 1910s. Mining companies developed additional beds during the latter half of the 1930s and World War II because economical surface deposits still existed and were inexpensive to develop. By the 1950s, the richest surface beds had been exhausted, but heavy equipment rendered previously uneconomical deposits cost-effective to work.

Features Common to Mine Resources

Mine sites often possess an array of archaeological, engineering, and architectural features that were originally components of the surface plant. To help researchers identify the components and organize their data, the Feature Types below are arranged under the common systems that comprised mine surface plants. The feature types noted below are in addition to those also found at prospects, and so the researcher should review Prospect Site Feature Types and see Section E for complete context.

General Feature Types

Adit: A horizontal opening usually less than 3 by 6 feet in-the-clear. Collapsed adits manifest as linear areas of subsidence. Tunnels were horizontal openings greater than 3 by 6 feet in-the-clear.

Anchor Pin: Workers hammered anchor pins into the ground to hold fast guy lines and cables for utility poles, trestles, ore bins, and other structures.

Building Platform: A flat area upon which a building stood. If possible, the type of building should be specified in the feature description.

Bulldozed Area: Mine sites commonly feature areas scraped by bulldozers for various purposes such as vehicle parking, maneuvering trucks, and storing materials.

Claim Marker: Prospectors erected claim markers at the corners of their claims, which were usually 600 by 1,500 feet in area. Markers ranged from cairns to blazes on trees to up-ended rock slabs. When a surveyor mapped and registered a patented claim, he usually etched the mineral survey number into a corner rock.

Claim Stake: A claim stake was the universally recognized form of claim marker. Claim stakes were usually 4x4 posts 4 feet high.

Cribbing: A latticework of logs or timbers that retained waste rock or earthen platforms.

Explosives Magazine: Organized mining outfits erected magazines to store explosives away from a mine's surface plant. Many magazines were blasted out of sandstone cliffs, some were dugouts, a few were stone structures, while others

were no more than small sheds. Most magazines were less than 10 by 10 feet in area.
Explosives Magazine Ruin: The collapsed remnants of a magazine.

Figure F 3.4: Miners often used dry-laid masonry for explosives magazines such as the one at the Mary Ann Mine on Davis Mesa. The structures are limited in size and feature small doorways. Source: Author.

Generator: By the 1950s, some mining outfits installed generators to provide electricity for lighting and machinery. Most generators were self-contained, similar in appearance to a portable air compressor, and rested on timber skids.
Generator Foundation: Generator foundations often manifest as parallel timber skids several feet wide and up to 8 feet long. The associated artifact assemblage should include a high proportion of small, electrical items and engine parts.
Generator Station: The location of a generator and an electrical substation.
Inclined Shaft: Inclined shafts descended at angles greater than 25 degrees and featured rail lines and catwalks on their floors. Inclined shafts required hoists.
Inclined Tunnel: Inclined tunnels descended at angles less than 25 degrees. Most featured rail lines and catwalks. If a rail line was present, then a hoist was required to winch ore cars up to the surface. If the tunnel was more than 5 feet wide and its floor smooth, then trackless haulage vehicles were probably used instead.
Loading Dock: Loading docks were ramps that allowed workers to unload heavy equipment and supplies off trucks. Loading docks usually feature retaining walls.
Machine Foundation: A timber, masonry, or concrete foundation for an unknown type of machine.

Mine Rail Line: A track that facilitated the movement of ore cars around a mine. Most rail lines featured rails spiked 18 inches apart, and those for locomotives had rails spiked 24 inches apart or more.
Mine Rail Line Remnant: When a mine rail line was dismantled, workers often left ties, impressions from ties, portions of rails, and the rail bed.
Open-Cut: Occasionally, ore bodies cropped out directly on ground-surface or were immediately underneath a thin veneer of sandstone. In such cases, miners blasted off the overburden, removed the ore, and left an incision known as an open cut.

Figure F 3.5: A stope was the chamber in which miners extracted ore. Stopes in uranium mines, in this case the Tramp, tended to be flat, broad, and supported by timbers. Source: Author.

Figure F 3.6: When miners followed ore beds from the surface down underground, they created open stopes, such as this one at the Tramp Mine near Saucer Basin. Open stopes are usually associated with rim mines. Source: Author.

Open Stope: A stope was the cavity or working area in which miners removed ore from a carnotite body. When directly accessed from the surface, the cavity was an open stope.

Parking Area: Many mines featured bulldozed areas dedicated to vehicle parking and maintenance. Parking areas usually feature high proportions of vehicle-related artifacts generated during repair and maintenance.

Pipeline: An assembly of pipes usually intended to carry water. Pipelines should not be confused with compressed air mains, which extended from a compressor into the underground workings.

Pipeline Remnant: Evidence of a disassembled pipeline.

Privy: Most mines of substance featured a privy for the crew's personal use. Privies usually are small, frame structures with a door and a bench with between one and several cutouts for toilet seats.

Privy Pit: A pit that underlay a privy. Pits tend to manifest as depressions less than 5 feet in diameter, often with artifacts and other materials in their bottoms. Privy pits usually possess buried deposits, some of which may be important.

Refuse Dump: A refuse dump is a concentration of cast-off hardware, structural materials, and domestic waste in a single location.

Refuse Scatter: In contrast to a dump, a refuse scatter is a disbursed assemblage of hardware, structural debris, and domestic rubbish.

Road, Drill: Drill roads were bulldozed through areas subjected to exploration drilling, and passed through but were not necessarily directly associated with a mine site. Drill roads saw light use and were usually 8 feet wide and rough.
Road, Access: Access roads were bulldozed for the trucks that delivered supplies and hauled ore away from specific mines. To accommodate laden trucks, the roads were well-graded and usually at least 10 feet wide.
Stable: A building that housed draft animals used for both underground and surface transportation. Stables were often crude and featured wide doorways, feed mangers, and oat boxes.
Stable Ruin: The collapsed remnants of a stable.
Storage Shed: Large mines often featured small, frame buildings in which workers stored equipment. The interiors of storage sheds are open and possess no structural features except for shelves and nails for hanging items. As an activity, storage generated few artifacts. If the artifact assemblage is high, then the building probably served another purpose.
Storage Shed Ruin: The collapsed remnants of a storage shed.
Structure Platform: An area leveled for an unknown structure. If the structure type is known, then the feature type should specify. Structural debris usually denotes the presence of a structure.
Tank: A vessel for either water or fuel.
Tank Foundation: In some cases, tanks were mounted to concrete or timber foundations.
Tank Platform: An earthen platform that supported a tank. Timber bolsters and garden hoses often remain.
Timber Dressing Station: Timber dressing stations tend to be represented by collections of raw logs and numerous cut wood scraps, usually on flat or gently sloped ground near the mine opening.
Timber Stockpile: A stockpile of mine timbers, often located near the mine opening. Mine timbers are usually 6 to 7 feet long and notched at both ends.
Transformer House: A transformer house was a small, frame building that enclosed a transformer station. The building usually featured insulators, a utility pole, and electrical artifacts.
Transformer House Platform: A platform that supported a transformer house. The artifact assemblage should include a high proportion of electrical items.
Transformer House Ruin: The collapsed remnants of a transformer house.

Figure F 3.7: Typical tunnels were horizontal, poorly formed, arched, and around 4 by 7 feet in-the-clear. Source: Author.

Figure F 3.8: The Paradox View No.1 Mine tunnel was intended for trackless haulage vehicles. The tunnel is around 6 by 7 feet in-the-clear and has a smooth floor. Source: Author.

Transformer Station: Transformer stations featured incoming power lines, transformers that converted the electricity to applicable voltage and amperage, and distribution lines to the mine facilities. Plank pallets suspended between two utility poles usually supported the transformers.

Trestle: A structure that supported a mine rail line, walkway, or pipeline. Workers often built small trestles on the flanks of waste rock dumps to support dead-end rail lines.

Trestle Remnant: Posts, single piers, or partial stringers left from a trestle.

Tunnel: A horizontal opening underground usually more than 3 by 6 feet in-the-clear. Collapsed tunnels often manifest as linear areas of subsidence. If the tunnel is wider than 5 feet and features a smooth floor, then trackless haulage vehicles were probably used to carry rock to the surface.

Utility Pole: A pole that supported an electrical or communication line.

Vertical Shaft: A vertical shaft was an opening underground that descended straight down. Shafts for ore production were usually at least 4 by 8 feet in area, and some were divided into compartments. The largest was the *hoisting compartment* and the smaller, usually less than 3 feet wide, was the *utility compartment*. Highly productive mines may have featured shafts with two hoisting compartments and one utility compartment. Evidence of a double-drum hoist should be associated with a three-compartment shaft. Collapsed shafts manifest as funnels of subsidence.

Workbench: Many mines featured outdoor, free-standing benches. Workers used light-duty benches for lunches, in which case domestic artifacts probably remain. Stout benches with drill-holes for small appliances, and artifact assemblages of industrial refuse, were used for equipment repair.

Compressed Air System Feature Types

Air Compressor: An air compressor was a machine that compressed air for rockdrills and other equipment. Mining outfits employed several types between the 1910s and 1970s, and they are noted below in chronological order. As a general rule, existing compressors are rare and important engineering features.

From the 1910s through the 1940s, mining companies with limited air needs used stationary, *straight-line belt-driven compressors*. This type of compressor featured a single compression cylinder and a broad flywheel that accommodated a belt. These units ranged in size from 2 by 5 feet to 4 by 9 feet in area and were bolted to stout foundations. A separate electric motor or, usually, a gasoline engine turned the belt.

Mining companies with substantial air needs relied on stationary *duplex belt-driven compressors* from the 1910s through the 1950s. Most ranged in size from 5 by 6 feet to 10 by 14 feet in area and consisted of a U-shaped cast iron body with a flywheel near center and compression cylinders at the open end. Duplex compressors were bolted to U-shaped concrete foundations and were powered by a motor or gasoline engine on a separate foundation. A belt passed from the engine around the compressor's flywheel.

Around the same time the above types were popular, machinery manufacturers offered the *petroleum compressor*, which consisted of a small, straight-line unit shafted to a petroleum engine. Their sizes were similar to the small, belt-driven compressors, and the machines were popular between the 1910s and 1930s.

The *portable compressor* was by far the most common type and was ubiquitous throughout the mining industry from the 1910s through the 1970s. Portable compressors featured a multicylinder compression unit, its drive engine, and a small receiving tank bolted to a trailer frame. Powerful units had four wheels while small versions rode on two wheels.

During the 1930s, compressor designs changed substantially and manufacturers introduced the *V-cylinder compressor*, which was based on the mechanics of the automobile engine. V-cylinder compressors featured a crankcase, several cylinders on top, and a radiator to dissipate heat. Small units possessed only several cylinders while large models had up to twelve, and most were belted to gasoline engines or motors.

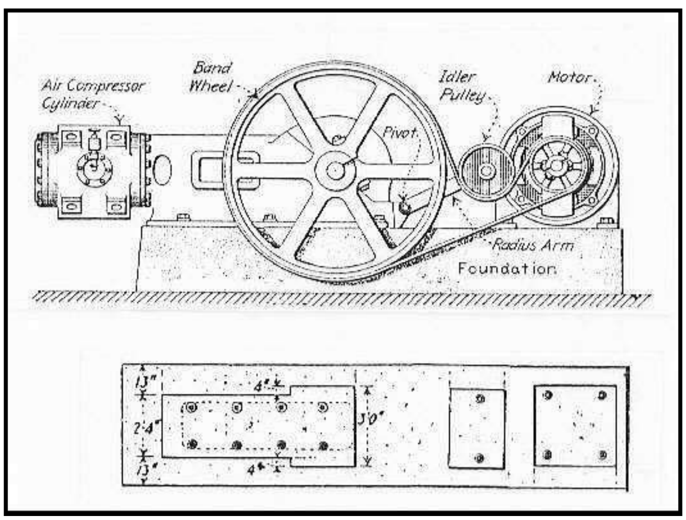


Figure F 3.9: The profile illustrates the type of small, belted compressor popular between the 1910s and 1940s. The plan view depicts the foundation, which features mounts for the compressor and motor. Source: Author.

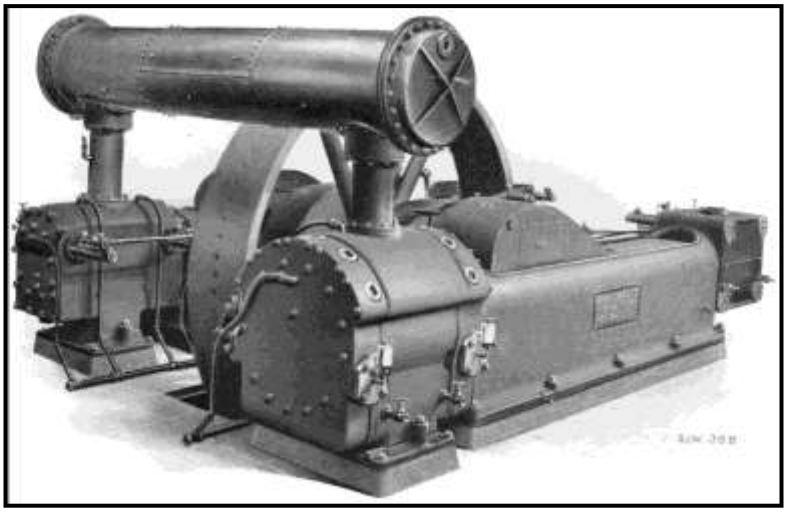


Figure F 3.10: The belt-driven duplex compressor was popular as a stationary unit because of its operating capacity. Originally, these machines were powered by gasoline engines, and some were also belted to motors where electricity was available by the 1940s. Source: Twitty, 2002:100.

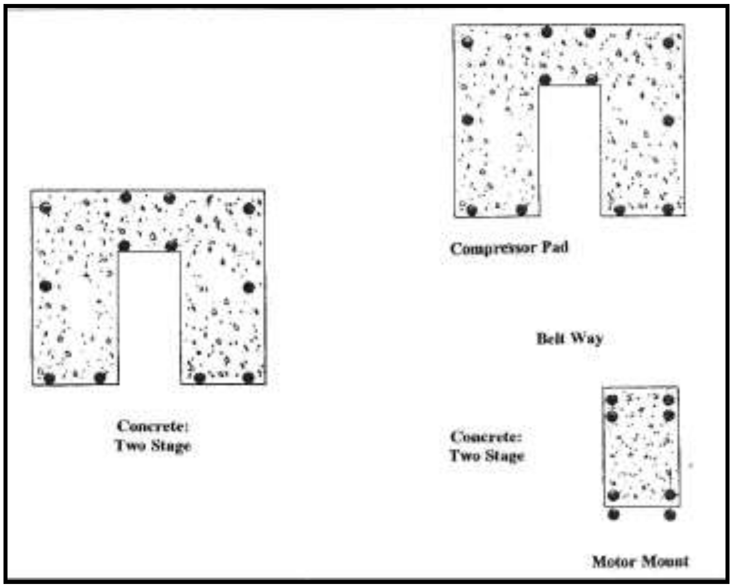


Figure F 3.11: The plan view depicts the common foundations for duplex compressors. The foundations range from 4 by 4 to 8 by 8 feet in area. Source: Twitty, 2002:109.

Figure F 3.12: The V-cylinder compressor, similar to a large engine, became one of the most popular types of stationary compressors after the 1930s. Note the foundation. Source: Twitty, 2002:274.

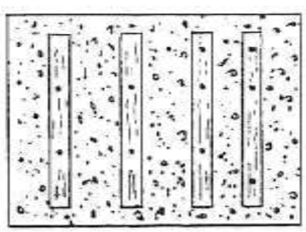


Figure F 3.13: The plan view at left depicts a common V-cylinder compressor foundation. Timber footers are embedded in a concrete rectangle around 3 by 4 feet in area. Source: Author.

Air Compressor Foundation: Because of their great weight and powerful motion, stationary air compressors had to be anchored to solid foundations. Workers often constructed timber foundations for small units and used either rock masonry or concrete for large models. In most cases, the compressor was removed when a mine was abandoned, leaving the foundation as the machine's only representation. Based on a foundation's footprint, the researcher can often determine the exact type of compressor.

Straight-line belt-driven compressors were bolted to foundations that featured a rectangular footprint and a flat top-surface studded with two rows of anchor bolts. A second, rectangular foundation for the drive engine, usually 3 by 3 feet in area or less, should be located nearby.

Duplex belt-driven compressors were bolted to U-shaped foundations studded with anchor bolts. A small, rectangular foundation for the drive motor should be located nearby and directly aligned with the open end of the compressor foundation.

Due to severe vibrations, *petroleum compressors* were usually bolted to stout concrete foundations often several feet high. The foundation is almost always rectangular, several feet wide, less than 9 feet long, and features two rows of anchor bolts.

Foundations for *V-cylinder compressors* tend to be fairly distinct and often feature an adjacent mount for a motor or engine. Compressors that featured several cylinders were often bolted to rectangular foundations between 4 by 5 feet and 3 by 3 feet in area, while the foundations for machines with numerous cylinders were several feet wide and up to 10 feet long. Workers often constructed foundations with a series of closely spaced timbers bolted to either an underlying concrete pad or buried timber footer.

Compressed Air Main: A pipeline that carried compressed air from a compressor into the underground workings.

Compressor House: Mines with expansive surface plants occasionally featured compressor houses to enclose air compressors and receiving tanks. Associated artifact assemblages usually include thick compressed air hoses, pipe and air fittings, air and oil filters, and motor oil cans.

Compressor House Platform: The platform that supported a compressor house. Compressor house platforms should feature a compressor foundation or pad, and the types of artifacts noted above.

Compressor House Ruin: The collapsed remains of a compressor house.

Compressor Station: Compressor stations refer to the general areas where workers parked portable compressors. The stations are often near the mine opening or on the nearest road. Associated artifact assemblages usually include thick compressed air hoses, pipe and air fittings, air and oil filters, and motor oil cans.

Hoisting System Feature Types

Boiler: A boiler generated steam usually for hoisting. Steam power was commonly employed at substantial mines during the 1900s and 1910s, and a few outfits may have used steam during the 1920s. Portable, self-contained boilers were the most popular because they were field-ready, easy to transport, and inexpensive. Portable boilers included *upright*, *locomotive*, and *Pennsylvania* models. Stationary, *return-tube boilers* were more efficient but saw limited use because of their cost to purchase, transport, and install. Each type and its application are discussed in Section E.

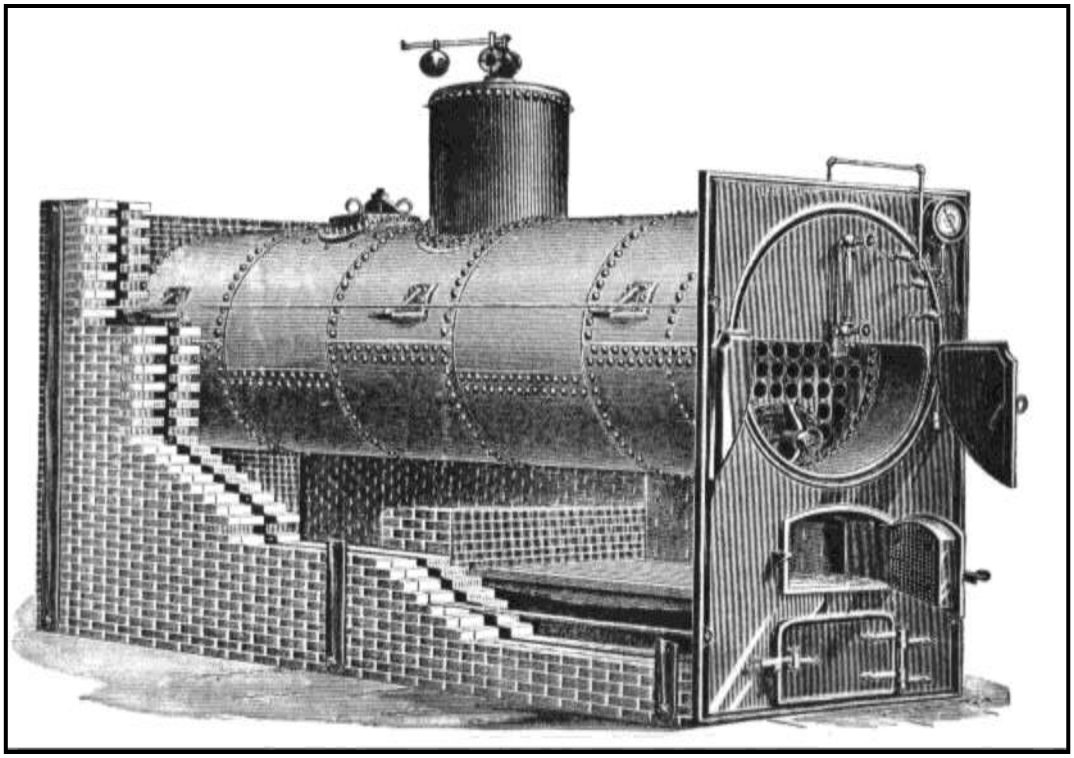


Figure F 3.14: The return-tube boiler saw use at large mines through the 1910s, and at mills through the 1930s. The unit consisted of an iron shell, a masonry setting, and a cast iron façade. Flue gases traveled from the firebox behind the façade, under the shell, and rose into a smoke chamber at rear. They reversed direction and returned through the flue tubes perforating the shell and escaped out a smokestack over the façade. The top doors permitted workers to swab out the flue tubes. Source: Rand Drill Company, 1886:44.

Boiler Clinker Dump: When workers shoveled residue out of a boiler's firebox, they usually dumped the material on the waste rock dump near the boiler. Boiler clinker dumps tend to be distinct and consist primarily of boiler clinkers, which are dark, scorious, ashy clasts created by burning coal. Boiler clinker dumps also usually include charred slate fragments, unburned bituminous coal, and structural and industrial hardware.

Boiler Foundation: Because portable boilers were self-contained and free-standing, mining outfits usually stood them on platforms located near the hoist. Occasionally, however, workers erected rock or brick foundations or pads to support the boiler. The artifact assemblage around a foundation or platform can help the researcher identify it as that for a boiler. The assemblage should include clinker, which was a scorious, dark residue, as well as unburned bituminous coal, ash, water-level sight-glass fragments, boiler grate fragments, and pipe fittings.

Some mining outfits installed *upright boilers* on square or circular dry-laid rock pads, or excavated a shallow pit underneath the boiler to allow ashes from the firebox to drop through. The pad's size should approximate the boiler's diameter.

Pennsylvania and locomotive boilers stood on skids, which usually required no support. However, where the ground was soft or uneven, workers often laid parallel rock alignments to prevent the boiler from settling. In the absence of rock supports, the skids occasionally became embedded in the ground and left two parallel depressions the length and width of the boiler. For locomotive boilers without skids, which were rare, workers erected rock or brick pylons to support the high rear, and laid a rock or brick pad that supported the firebox end.

In some instances, all the bricks for *return-tube boiler* settings were removed, leaving only the underlying foundation. Typical return-tube boiler foundations were, flat, rectangular, and around 10 by 22 feet in area. Workers usually used rocks, although wealthy companies substituted bricks. A boiler foundation should feature clinker and charred bricks.

Boiler Setting Ruin: Often, when a mine closed, the key components comprising a return-tube boiler were salvaged, leaving only the masonry setting. Over time, the walls collapsed, leaving rectangular piles of rocks or bricks, some of which may have been scorched. In many cases a setting ruin may still retain the *bridge wall*, which was a low row of bricks between the walls that forced flue gases against the boiler's belly. When visible, the bridge wall crosses the foundation near its center. Artifacts such as ash, clinker, and long masonry bolts are usually associated with setting ruins.

Headframe: A headframe was a structure that stood over a vertical shaft, and it guided the hoist cable and facilitated the movement of materials between the surface and the underground workings. Mining operations erected four general types of headframes to meet the needs of ore production.

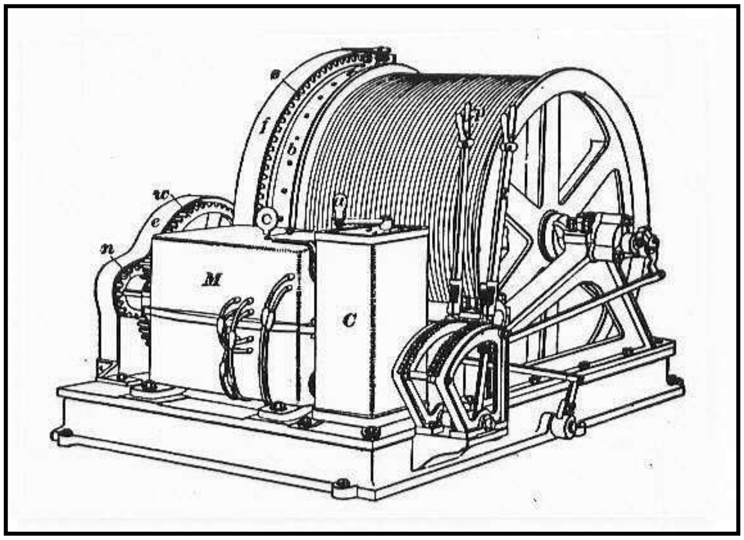
The *two-post gallows* headframe was the most popular type during the 1910s, and it consisted of two posts on timber footers, backbraces that supported the posts, and cross-members at top. The cross-members featured a large pulley known as a *sheave* that guided the hoist cable into the shaft. Two-post gallows headframes were light-duty and inadequate for substantial ore production. The second was the *four-post derrick*, which consisted of four posts joined with cross-braces and diagonal beams, all supported by two backbraces. The third is the *six-post derrick*, which featured six posts instead of four. The last is a large *A frame*. Production-class headframes were formally engineered, more than 25 feet high, and stood on well-built timber or concrete foundations. In terms of materials, mining outfits usually used timbers to save capital but constructed large and well-built headframes with steel. Intact headframes are important and rare.

Headframe Ruin: The collapsed remnants of a headframe.

Headframe Foundation: Headframe foundations usually manifest as parallel timbers that flank a shaft and extend toward the area where a hoist was located.

Hoist: Almost all shaft operations required a hoist to raise rock out of the underground workings. The hoist's basic form remained fairly constant between the 1900s and 1970s, and most changes involved different sources of power. During the 1900s and 1910s, *single-drum steam hoists* and *gasoline hoists* were used almost exclusively. Afterward, gasoline hoists, *single-drum* and *double-drum electric hoists*, and compressed air-powered *tuggers* saw extensive application. These are discussed in Section E.

Figure F 3.15: The illustration depicts a common single-drum electric hoist. The motor is in the case, the upright box is a speed controller, and the motor turned the drum via gearing. Source: Twitty, 2002:224.



Hoist Foundation: Nearly all mechanical hoists were anchored to foundations to keep them in place, and a foundation's footprint can reflect the type of hoist. Because of their ease of construction and low cost, prospectors usually assembled hoist foundations with timbers, and occasionally with stone or concrete. Timber foundations decay and become buried over time, and they often manifest today as rectangular groups of four to six anchor bolts projecting out of a hoist house platform.

Foundations for *single-drum steam hoists* are usually rectangular, flat, and feature at least four anchor bolts. They can range in size from 6 by 6 feet to as little as 2 by 3 feet in area. If the mine had a steam hoist, then evidence of a boiler should be present.

Foundations for *gasoline hoists* are fairly distinct. For factory-made hoists of the 1910s, the foundation is usually an elongated rectangle at least 2 by 6 feet in area oriented toward and aligned with the shaft. Foundations of this vintage usually feature at least two rows of three anchor bolts, with the rear two closer together than the rest. The custom-made hoists of the 1950s were bolted to rectangular foundations with irregular patterns of anchor bolts. Gasoline hoists usually leave distinct artifact assemblages that include thin wires, spark plugs, small pipes, fine machine parts, and motor oil cans.

Foundations for *single-drum electric hoists* are similar to those for steam hoists. If the hoist was electric, then electrical artifacts should remain. Foundations for *double-drum hoists* tend to possess an elongated rectangular footprint oriented 90 degrees to the shaft. They usually consist of concrete or masonry, feature a perimeter of anchor bolts, and wells for the cable drums. Small anchor bolts on the edges of the drum wells often braced brake shoes.

Figure F 3.16: Most mines had small, light-duty gasoline and compressed air hoists, which were bolted to simple timber and plank foundations such as the one in the photo. The foundation is rectangular and aligned with the shaft. Source: Author.

Figure F 3.17: These timbers mounted a gasoline hoist at the Republican Mine in Long Park. Source: Author.

Figure F 3.18: Compressed air hoists known as air tuggers were often bolted to timber mounts such as the one illustrated. The structure is 2 by 2 feet in area and aligned with the shaft. Source: Author.

Figure F 3.19: The Radium Hill No.10 Mine on Wedding Bell Mountain featured a typical hoisting arrangement. The hoist was mounted on a plank floor built over a prefabricated ore bin. Workers constructed a flimsy, frame hoist house around the floor. A rail line extended right over a trestle, down the inclined ramp, and into the shaft. Guy cables keep the overhanging structure from toppling over. Source: Author.

Hoist Frame: At inclined shafts, workers mounted hoists to timber platforms that consisted of a frame or plank floor elevated by posts. The platforms tended to be at least 6 by 8 feet in area and usually featured the hoist at the rear (farthest from the shaft). Some hoist platforms were built directly over an ore bin, and others were partially buried with waste rock as ballast.

Hoist House: A structure that enclosed a hoist, the hoist's power source, and, during the 1910s, a blacksmith shop. Hoist houses were usually located at least 20 feet away from the shaft. At inclined shafts, the hoist house usually stood on the hoist frame.

Hoist House Platform: An earthen platform, usually graded with cut-and-fill methods, which supported a hoist house. The platform often features evidence of a hoist and a shop.

Hoist House Ruin: The collapsed remnants of a hoist house.

Hoist Mount: Small hoists such as compressed air powered units saw extensive use at inclined shafts and tunnels. These hoists were mounted to squat, timber frames several feet in area and as high with bolts on top to fasten the hoist. Hoist mounts were usually placed nearby and aligned with the shaft, and in some cases, were anchored to the top of an ore bin.

Ore Storage Feature Types

Grizzly: A grizzly was a screening structure that separated blasted rock by size. Earth-moving equipment dumped mixed rock onto the grizzly, which usually consisted of heavy iron rods, and fine material passed through while boulders rolled off. The boulders were usually waste while the fine material tended to include carnotite.

Figure F 3.20: Mining outfits dumped ore onto grizzlies to screen out waste cobbles. A grizzly reflects the use of heavy equipment such as front-end loaders. Source: Author.

Ore Bin: The uranium industry favored three general types of ore bins. *Flat-bottom bins* usually consisted of plank walls and a plank floor nailed to joists, all assembled on a flat platform. Large bins often featured a gate through which workers shoveled ore into an adjacent truck. *Sloped-floor bins* possessed a floor often with a pitch of 45 degrees, and they usually stood on foundations of log cribbing and posts. Large bins may have featured multiple cells for different grades of ore, and ore chutes projected out of the front so workers could discharge the contents into trucks. Prefabricated, factory-made *steel bins* were square, featured pyramid bottoms, and stood elevated on steel legs. A truck parked underneath, and a worker opened a sliding hatch to unload the ore. The principal mining companies usually installed these bins at highly productive mines.
Ore Bin Platform or Foundation: A platform or foundation that supported an ore bin that has been dismantled. Open, flat-bottom bins usually stood on a platform located on the flank of a waste rock dump so workers could dump payrock from an ore car. Sloped-floor bins usually stood on a combination of a platform, which supported the bin's head, and log or timber pilings that supported the remainder.
Ore Bin Ruin: The collapsed or partial remnants of an ore bin.

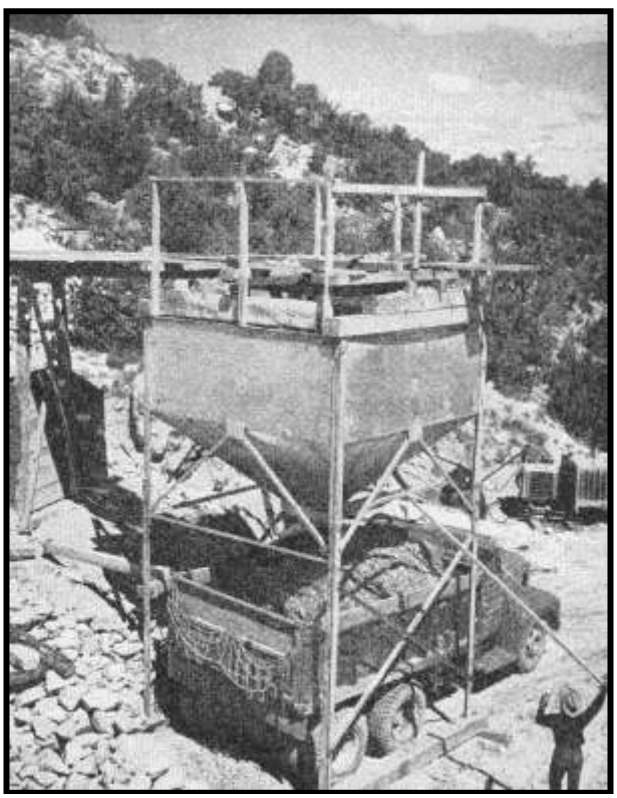


Figure F 3.21: The region's large mining companies provided their leasing outfits with prefabricated steel bins for ore storage. In the mid-1950s photo, the worker at lower right lifts a long lever to open a hatch in the bin. Note the trestle crossing to the bin top. These bins can still be found at all types of uranium mines. Source: unknown.

Figure F 3.22: Custom-made, plank ore bins were common ore storage structures. The bins, such as the one at the Cripple Creek Mine, were often little more than plank boxes elevated on posts, which allowed a small truck to park underneath and receive ore. Source: Author.

Ore Chute: A chute that directed payrock into an ore bin or into a vehicle.
Ore Chute Remnant: The collapsed remnants of an ore chute.
Ore Dump: An ore dump was a low platform, plank-lined depression, or area with a plank backstop on which miners deposited ore for storage. Ore dumps were at ground-level, and miners input payrock from trackless haulage vehicles, and transferred ore into trucks with front-end loaders. Because ore dumps are associated with heavy equipment, they date to the 1960s and later.
Ore Loading Area: Most mining outfits, regardless of size, graded an area around an ore bin so trucks could turn around, park, and receive loads of ore.
Ore Platform: An ore platform was an elevated plank floor onto which miners dumped small volumes of ore for shipment. The structure usually stood adjacent to and over a road so miners could easily transfer the ore into a parked truck. Ore platforms tend to pre-date the 1940s and are usually found at small mines.

Figure F 3.23: Ore chutes were common storage structures at rim mines, such as the Tramp in the photo. Lessees favored chutes because they were inexpensive and easy to build. Source: Author.

Ventilation System Feature Types

Ventilation Blower: A ventilation blower forced fresh air into a mine's underground workings. Prior to radon standards passed in the early 1960s, most blowers were relatively small, and afterward, they were substantial. They stood adjacent either to the mine opening or a ventilation shaft. Two types of blowers proved popular. The *propeller fan* was similar to an enlarged household fan and was encased in a sheet iron shroud with a port to attach ventilation tubes. The *centrifugal blower*, by far the most popular, can be subdivided into two categories. The first was boxy and featured a ring of vanes in a sheet iron shroud, and the second was curvaceous, thin, and encased in a cast-iron shroud. Most blowers were belted to an adjacent motor or gasoline engine.

Ventilation Blower Foundation: Large blowers were anchored to simple foundations usually consisting of timbers embedded in the ground. The foundations tended to be 3 by 4 feet in area or less and featured four anchor bolts. A motor or small gasoline engine that powered the blower was usually bolted to an adjacent foundation.

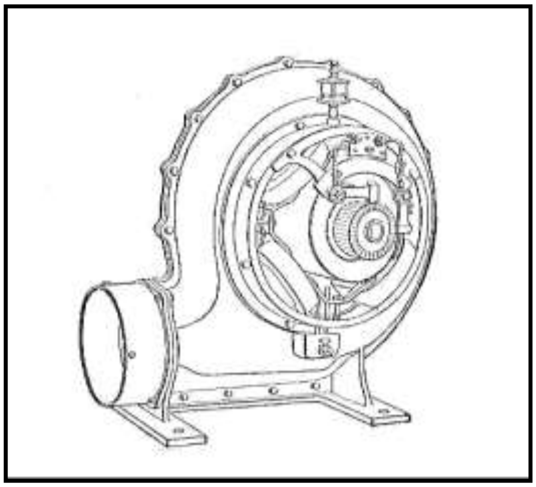


Figure F 3.24: At left is a common ventilation blower used to force fresh air underground. Ducting was fastened to the nozzle, and a belt turned the machine. Source: International Text Book Company, 1899, A41:146.

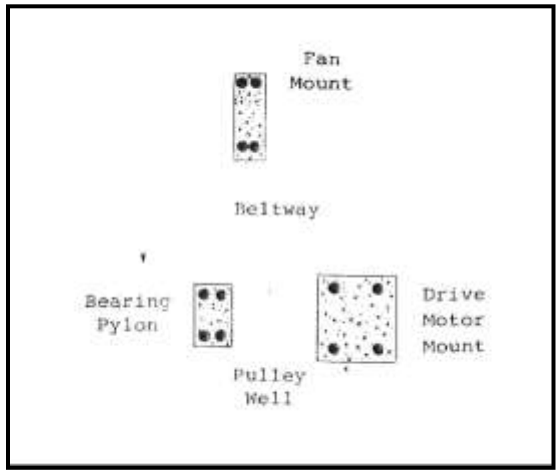


Figure F 3.25: The plan view at right depicts a typical concrete foundation for a ventilation blower and its drive motor. Source: Author.

Ventilation Shaft: A ventilation shaft was a circular conduit bored from the surface down into mine workings. Some shafts were as much as 3 feet in diameter and doubled as escape ways. Most, however, were holes around 8 inches in diameter bored by rotary drill-rigs. If the shaft features a ventilation stack (see below) and associated artifacts such as motor oil cans and engine parts, it probably had a blower.

Ventilation Stack: Miners often installed a stack of tubing over a ventilation shaft for two purposes. One was to prevent material from rolling into and blocking the shaft, and the other was to serve as a connection with a blower. Stacks ranged from pipes to carbide and oil drums welded together. If the stack features brackets and circular cut-outs, it probably anchored a blower.

Figure F 3.26: Ventilation stacks stood over ventilation shafts, and they controlled the flow of fresh air down into a mine's underground workings. Blowers often forced the fresh air into the structures. The stack at the Cripple Creek Mine features a blower hole at its base. Miners assembled the stack with salvaged oil drums. Source: Author.

Shop Feature Systems

Backing Block: Some shops featured backing blocks to help workers sharpen the drill-steels used by rockdrills. A backing block consisted of an iron rod 4 inches wide and up to 8 feet long embedded in the shop floor near the forge. The block's surface featured a series of deep divots where the blacksmith rested the drill-steel's butt, and he leaned the drill-steel's neck against an anvil to brace the item for sharpening. Many mining outfits substituted a railroad rail for the iron rod.
Drill-Steel Sharpening Machine: By the 1940s, these machines were used almost exclusively to sharpen drill-steels. Most sharpeners were upright units 2 by 3 feet in area, 3 to 5 feet high, and featured an assemblage of clamps and power hammers mounted on a cast iron pedestal. Sharpeners were always located in a shop or on a shop platform.
Drill-Steel Sharpening Machine Foundation: Because drill-steel sharpening machines destroyed unpadded concrete foundations over time, they were usually bolted to foundations consisting of timbers or timber footers over concrete. Sharpener foundations are always located in a shop or on a shop platform, are usually 2 by 3 feet in area, and possess four to five anchor bolts.

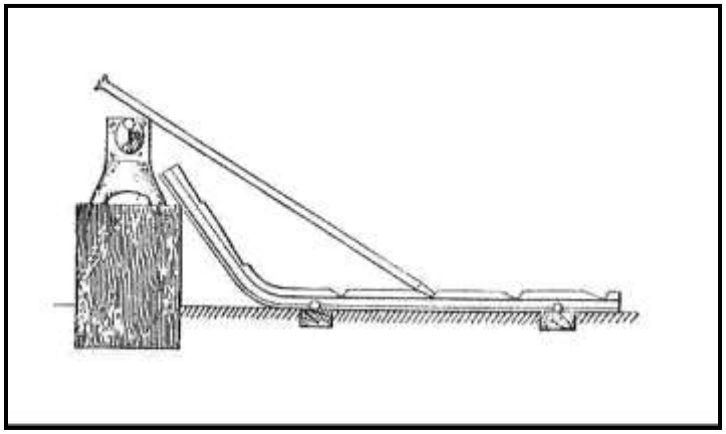


Figure F 3.27: The profile illustrates a backing block, which shop workers used to brace hot drill-steels during sharpening. The drill-steel rests in a divot in a steel bar, and its neck rests against an anvil on a timber stand, ready for the blacksmith's hammer. Backing blocks were embedded in the shop floor adjacent to the forge. Source: Twitty, 2002:63.

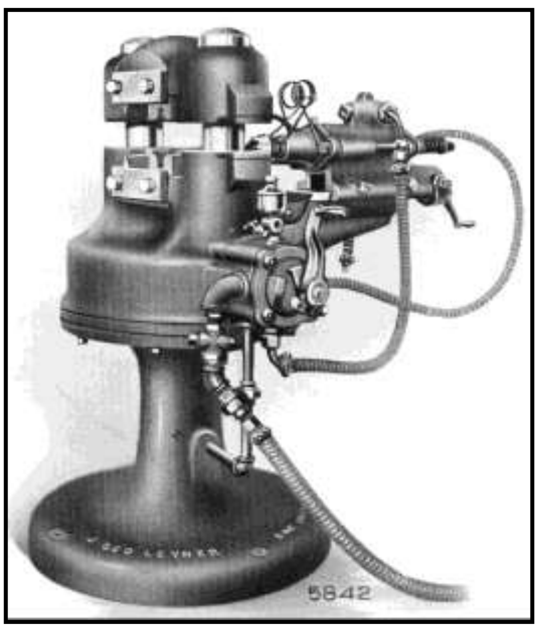


Figure F 3.28: Shortly after 1910, leading rockdrill makers introduced a compact drill-steel sharpening machine around 5 feet high. The device, purchased by well-capitalized mining companies, expedited the drill-steel sharpening process. Source: Twitty, 2002:65.

Forge: Almost every mine shop featured a forge where blacksmiths heated iron. Several types of forges proved popular, and most were 3 by 3 feet in area and 2 feet high. The *gravel-filled rock forge* consisted of dry-laid rock walls filled with gravel. The *wood box forge* consisted of plank walls retaining gravel fill. The free standing *iron pan forge* featured an iron pan supported by iron legs. Companies that required high volumes of work also installed cylindrical iron and square iron box forges usually 4 by 4 feet in area.
Forge Remnant: Over time, rock- and wood box forges decay, leaving mounds of gravel that often feature anthracite coal, clinker, and forge-cut iron scraps.
Lathe Foundation: Some mechanized shops featured a lathe to facilitate metal- and woodwork. Lathes were usually bolted to parallel timbers around 2 by 8 feet in area or less.
Power Hammer Foundation: Advanced, mechanized mining companies installed power hammers in their shops to expedite metalwork. Many power hammers consisted of obsolete rockdrills bolted to timber posts, and they pounded items clamped to an underlying table. When removed, power hammers can be denoted by a heavy timber post up to 6 feet high and an adjacent timber stump where the table was located.
Shop: Shops at mines featured facilities for the manufacture and repair of tools, hardware, and machinery. Some shops also facilitated carpentry. Nearly all shops included blacksmith facilities at the least and some were equipped with power-driven appliances.
Shop Platform: The platform that supported a shop. An artifact assemblage including forge clinker, pieces of hardware, forge-cut iron scraps, cut pipe scraps, and cut wood scraps can help identify a shop platform.
Shop Remnant: The collapsed remains of a shop.
Shop Refuse Dump: A deposit or scatter of forge clinker, forge-cut iron scraps, cut pipe scraps, and pieces of hardware. Carpentry shops left an abundance of cut wood scraps, sawdust, and hardware.

F 3.2: Mine Significance

The great importance of mining to the uranium industry seems to be an elementary conclusion. Mining began in 1898 with the discovery of carnotite on Roc Creek and spread along the Dolores River corridor and in Paradox Valley. Seven years later, deposits of roscoelite were brought into production around Placerville. During the 1910s, prospectors and mining companies defined the principal ore-bearing regions in western Montrose and San Miguel counties, laying the foundation for future uranium production.

The mining industry was particularly important during six Periods of Significance, which are discussed in detail in Section E. During the first Period of Significance (1898-1905), mining in Montrose County contributed to and was a function of events and trends important on local, statewide, national, and worldwide levels. On national and worldwide levels, the mining industry produced the world's first carnotite ore and became the principal source of uranium, from which European scientists extracted radium. The scientists then used the radium to pioneer early work in nuclear physics and medical technology. Toward the end of Period, the medical industry made great use of radium to cure some types of cancer. Carnotite was also distributed to mineralogists and geologists at leading scientific institutes for study.

On statewide and local levels, the mining industry drew the attention of both the scientific community and European radium interests to Montrose County, and this lasted through World War I. Mining also brought permanent settlement to regions that were previously empty, and contributed to the economy.

Major trends developed in both Montrose and San Miguel counties during the second Period of Significance (1906-1922). During the first years of the Period, the counties claimed status as the world's second-most important sources of uranium (for radium) and vanadium, and ascended to the most productive by World War I. The medical industry continued to use radium as a cure for cancer, and the steel industry consumed vanadium as an alloy for hardened steel. This latter trend was significant in two arenas. First, vanadium alloy steel allowed equipment manufacturers to produce durable goods, tools, and machinery that were superior to previous versions. Second, the hardened steel was a crucial material for the weapons and armor used during World War I. When the Allies exhausted their war materials during the latter half of the war, they turned to Colorado as a source of vanadium. Both European and American arms makers then produced enough weaponry and other wartime supplies to help the Allies gain victory over the Axis.

The mining industry had impacts on local and statewide levels. The industry brought permanent settlement, development, and infrastructure to the counties. Further, until 1922, when mining collapsed, the industry was the region's economic foundation and drew a much greater population than any previous time. The industry also instituted a statewide system of mining, milling, and radium and vanadium refining. Specifically, much of the carnotite and roscoelite was concentrated in the region's mills and then shipped to refineries in Denver and Boulder. A significant portion of the ore was also sent to mills and refineries in Pennsylvania and Chicago.

During the third Period of Significance (1935-1940), the mining industry was associated with another set of trends that were important on local, statewide, national, and worldwide levels. On national and worldwide levels, western Montrose and San Miguel counties resumed their status as the world's most important source of vanadium. In addition, they produced most of the nation's uranium, which was refined for medical radium. The vanadium became a direct contribution to the steel industry, which manufactured hardware and equipment for the public works projects that helped bolster the nation's dismal economy.

On statewide and national levels, a few large mining companies gained control over the vanadium and radium industries during the third Period. USV, VCA, and North Continent acquired most of the productive mines and operated the region's only mills. These companies were able to profit only by mining and milling in economies of scale, and constituted most of the region's uranium industry.

On a local level, carnotite mining revived the region's economy, which was important in the poor climate of the Great Depression. Prior to 1935, the region had few sources of income and no significant industries. Mining provided needed jobs and a stream of financial support that made its way into the local communities.

During the fourth Period of Significance (1941-1945), the mining industry participated in yet more trends that were important on all levels. On both national and world-wide levels, the industry was a product of and directly contributed to the Manhattan Project. Montrose, San Miguel, and surrounding counties generated 15 percent of the uranium consumed by the Manhattan Project. Further, the region was the third-most important contributor and the principal domestic source of uranium. Much of the material was derived from reprocessing old mill tailings, and when these had been exhausted, mining companies then turned to the region's mines for crude ore. By producing uranium, the industry contributed directly to the establishment of the nation's first nuclear arms program, the development of the world's first nuclear bombs, and the only wartime use of such weapons in history.

On a national level, the counties were the most important domestic source of vanadium, which the Federal Government designated a strategic metal during World War II. Repeating the trend of World War I, vanadium was a key alloy used to manufacture weapons and armor. The region's mining industry contributed directly to the war effort through its vanadium production.

By producing uranium and vanadium, the mining industry became involved in the Federal Government's new trend toward strict regulation and control over strategic metals. The government was the sole buyer and refiner of both metals, and it regulated production, milling, shipping, acquisitions, and use. The result was a complex system of Federal agencies that have evolved and still exist today.

The uranium and vanadium mining industry played several roles fundamental on a local level. The industry was the region's economic backbone, and the increased exploration, production, and development lifted the region out of the Great Depression and improved the living conditions. The industry was also the region's principal employer and drew a larger population than any previous time period. In support, the Federal Government completed numerous civic and infrastructure improvements such as housing, community services, utilities, communication, and roads. These aspects were not only important to uranium and vanadium production during World War II, but also served as a foundation for the Cold War uranium boom of the 1950s.

The mining industry shaped the cultural climate of the two counties. The industry unified the region's communities because they embraced their role as direct contributors to the war effort. They understood that their contribution was vanadium for weapons and armor and only later realized that the uranium used in the atomic bombs was a part of this.

The Cold War uranium boom was one of the mining industry's most important Periods of Significance (1946-1963). This Period featured trends similar to those of World War II, as well as new ones. On both national and world-wide levels, the industry directly contributed to the AEC's Cold War nuclear weapons programs. Their association is substantial because the counties were one of the most important sources of uranium in the free-world during the first half of the 1950s. During the latter half of the decade, other regions on the Colorado Plateau became as important, but the counties remained vital. By producing uranium, the region's mining industry participated in the development of nuclear weapons, the Cold War, and the resultant impacts on the world's social and political structures.

On local and statewide levels, the Cold War uranium boom was so intense that it rivaled Colorado's past mineral rushes. The boom elevated the regional economy to new heights and brought capital that was distributed to businesses elsewhere in the state. The region's population increased again and participated in several important social trends. Class was among the trends. Most of the industry's white-collar workers belonged to a growing middle class, and a minority were wealthy elite based in Denver and the East. The profits realized from mining reinforced the positions of the elite while contributing to the growth of the middle-class, which ultimately became one of Colorado's economic and political backbones. Because the mining companies depended on wage laborers, company operations ensured the continuation of a working class.

The system of leasing claims and mines had a major local impact on class structure. During the Cold War boom, lessees operated the far majority of uranium mines in the counties. Some individuals spent their entire mining careers leasing mines, and many began as partners in small outfits. Over time, some of the lessees reinvested their profits in equipment and employees, and ultimately formed multi-operation companies. Lessees enjoyed greater freedom than company employees, and had the potential to earn more money when efficient. Leasing allowed many individuals to ascend from lower to middle classes, and even to prominent positions in the communities.

The very nature of the workforce that made uranium mining possible constituted another form of social structure. Activity among the various prospects, mines, and mills created a pronounced employment market that drew workers from points throughout Colorado and other areas in the West. The cycles of boom and bust inherent to uranium mining required that the workers be mobile, which contrasted sharply with Colorado's sedentary rural culture. Each boom drew laborers from a variety of backgrounds while busts propelled them to other areas and economic sectors in Colorado and elsewhere in the West. The result was a mobile, adaptable, and diverse society.

The uranium mining industry in the counties is strongly allied with trends involving Native Americans. During the 1950s, mining companies in the Southwest began employing Native Americans, primarily Navajos and Utes, in exchange for access to uranium ore on reservations. The Indians worked primarily underground and were quickly recognized as expert miners. Because of this reputation, companies in Montrose and San Miguel counties actively recruited Navajos, who ultimately constituted a significant proportion of the workforce. In so doing, the mining industry became an agent that brought large numbers of Indians off the reservations, provided them with training and employment, and placed them in an environment where they acculturated somewhat. The workers then improved the economies of their reservations when they returned with their earnings.

During the fifth Period, the AEC and private industry permanently shaped the cultural geography of the Colorado Plateau, and left a permanent imprint in Montrose and San Miguel counties. In support of mining, the Federal Government and industry improved the highway system, graded over 1,000 miles of gravel roads, expanded the electrical grid, completed civic improvements, provided medical services, and built schools. Industry invaded most of the formerly empty mesas, and mining camps and isolated residences became home to a disbursed population of workers.

Last, the Federal Government and private industry created a variety of environmental problems that would last into present-day. Massive waste rock dumps at the mines began eroding into drainages and contributed radioactive metals to the San Miguel and Dolores rivers. The millsites became centers of hazardous waste compounded by tailings, chemicals, and heavy metals. Some of this material became airborne while much made its way into local streams and rivers. Ultimately, this contributed to passage of modern environmental legislation.

The sixth and last Period of Significance (1974-1980) saw the development of new trends, as well as the continuation of several established historical patterns. During the sixth Period, the nuclear power industry became one of the nation's major sources of electricity. The success of nuclear power hinged on the uranium mining industry because the industry was the principal supplier of uranium fuel. By providing uranium, mining companies in Montrose and San Miguel counties contributed to the rise of nuclear power, which is still important today.

On a statewide level, Colorado was among the most important sources of uranium and vanadium in the free-world. A significant proportion of the uranium produced during the sixth Period came from Colorado, and in particular Montrose and San Miguel counties. In association, uranium mining continued to be the economic foundation, major employer, and agent of development in the counties.

F 3.3: Mine Registration Requirements

Rim Mine: As a Property Subtype, rim mines tend to be simple, common, and can range in age from the late 1890s into the early 1980s. Because structures and equipment were usually removed when rim mines were abandoned, the physical integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation. Examples retaining high degrees of archaeological integrity are uncommon, and those with engineering or architectural features are relatively rare. For a rim mine to be eligible, it must possess integrity relative to one of the uranium industry's Periods of Significance.

Some of the seven aspects of historical integrity defined by the NRHP are valid for rim mines. The aspect of Location applies to standing structures and intact machinery, which are usually limited to large sites. Standing structures and intact machinery are often important and can contribute greatly to a resource's integrity, but to do so, they must be in their original places of installation.

For a rim mine to retain integrity of Design, the resource's material remains must convey the mine's organization, planning, and engineering. In most cases, the aspect of Design does not apply because rim mines were worked with little advanced planning. Instead, mining outfits usually extracted ore as they encountered the material and abandoned the property when finished. Systems for developing the ore bodies and transporting payrock were designed for extensive rim mines, and for such sites, the aspect of Design should be considered. It must be remembered that most resources lack intact structures and equipment, and that archaeological features and artifacts can sufficiently constitute integrity of Design.

The aspect of Setting refers to the area surrounding the resource and whether that area conveys a sense of mining or the environment of when the mine operated. The setting may possess natural qualities such as sandstone cliffs or cultural landscape features like other mines. To retain integrity, both the Setting and the resource itself must not have changed a great degree from their Period of Significance. The removal of structures and machinery are an exception. If the resource is isolated, then the natural landscape should be preserved. If the resource lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity.

The aspect of Feeling refers to a resource's ability to imbue today's visitors with a sense of the past and mining history. To retain integrity of Feeling, the resource should possess tangible manifestations, intact features, and lie in an undisturbed setting.

The aspect of Association refers to a resource's ability to clearly represent a specific type of mine. In sum, a researcher should be able to examine a site's physical remains and reconstruct the mining operation in a virtual sense. This requires the resource to retain an intact assemblage of archaeological features and artifacts at the least. Intact structures and equipment are important additions.

In addition to possessing integrity, rim mines must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A should be associated with important trends and events. Some of these can be extracted from Section E, and Subsection Feature 3.2 (above) discusses additional events, trends, and themes that were important to the uranium mining industry.

Rim mines may be eligible under Criterion B if they can be clearly associated with an important person. The individual have spent an appreciable amount of time on-site or played a significant role in its development. The site, as it exists today, should retain integrity from that person's period of occupation or participation. Overall, it is difficult to directly attribute a given rim mine to an important person because most rim mines were small and briefly occupied. For this reason, few of these resources can be expected to be eligible under Criterion B.

Most rim mines will probably not be eligible under Criterion C because they are common, possess limited physical integrity, and offer few important characteristics and attributes. However, if the site is well-preserved and is a sound representation of a rim mine from a specific Period of Significance, then the resource may be eligible under Criterion C. Intact structures and machinery can lend to a site's eligibility because they are uncommon and important representations of engineering and technology. Size of operation is not a critical consideration. Small rim mines played an important role because they collectively yielded a large share of the overall uranium industry's total production. Large rim mines were also important because they generated large tonnages of ore on an individual basis, and the ore was often rich.

Few rim mines will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions may exist, however. If the resource possesses building platforms and privy pits, testing and excavation of associated buried archaeological deposits may reveal information regarding uranium miners' lifestyles, social structures, and the workplace. Little is currently known regarding these important arenas of inquiry because they received scant coverage in archival sources. As a result, archaeological investigations will be one of the most important means of addressing research questions.

Few rim mines will be eligible under Criterion G because most sites less than 50 years old are not important enough to qualify. However, a site may be eligible if it meets several conditions. First, the site should date to one of the uranium industry's last two Periods of Significance. Second, the site must be a well-preserved example of a rim mine. Third, the mine must have been noteworthy in of itself when active, or been a component of a substantial operation involving several other mines.

Tunnel Mine: As a Property Subtype, tunnel mines are fairly common and can range in age from the late 1910s into the early 1980s. Because structures and equipment were usually removed when the mines were abandoned, a site's physical integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation. Examples of tunnel mines that retain high degrees of archaeological integrity are uncommon, and those with engineering or architectural features are relatively rare. For a tunnel mine to be eligible, it must date to one of the uranium industry's Periods of Significance.

Many of the NRHP's seven aspects of historical integrity are valid for tunnel mines. The aspect of Location applies to standing structures and intact machinery, which may be encountered at large and complex sites. Standing structures and intact machinery are often important and can contribute greatly to a resource's integrity, but to do so, they must be in their original places of installation. Machinery intended to be portable, however, presents a special problem regarding location. Machines such as drill-rigs and trailer compressors were designed to be mobile and their locations changed. Hence, the aspect of Location for portable equipment can be argued as its general area of use.

For a resource to retain integrity of Design, the resource's material remains must convey the mine's organization, planning, and engineering. Often, successions of operators reworked the same mines and changed the surface facilities, leaving evidence of sequential occupation. When this was the case, a site can possess integrity of Design if its material remains reflect the evolution of the surface facilities over time. By studying archival information and material evidence, the researcher can determine when specific surface facilities were built and abandoned, and thereby establish a chronology of the resource's evolution. It must be remembered that most resources lack intact structures and equipment, and that archaeological features can constitute integrity of Design.

Integrity of Setting refers to whether the area surrounding the resource conveys a sense of mining or the environment of when the mine operated. The setting may possess natural qualities or constitute a cultural landscape. To retain integrity, both the Setting and the resource itself must not have changed a great degree from their Period of Significance. The removal of structures and machinery are an exception. If the resource is isolated, then the natural landscape should be preserved. If the resource lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. It should be remembered that bulldozing is a contributing factor to the landscape.

The aspect of Feeling refers to a resource's ability to imbue today's visitors with a sense of the past and mining history. To retain integrity of Feeling, the resource should possess tangible manifestations, intact features, and lie in an undisturbed setting.

The aspect of Association refers to a resource's ability to clearly represent a tunnel mine. In sum, a researcher should be able to examine a site's physical remains and reconstruct the mining operation in a virtual sense. This requires the resource to retain an intact assemblage of archaeological features and artifacts at the least. Intact structures and equipment are important additions.

In addition to possessing integrity, tunnel mines must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one of the areas of significance noted in Subsection E 3.2 (above), as well as events and trends important to the uranium mining industry. Large mines tend to be more closely allied with important trends and themes because of their high production levels and large workforces.

Tunnel mines may be eligible under Criterion B if they were associated with an important person. Large complexes in particular may be traced to important individuals such as engineers, and in these cases, they can be eligible under Criterion B. In general, the person must have spent an appreciable amount of time on-site or played a fundamental role in its development. It should be noted that an important person's investment in a property or involvement with a company is too indirect an association for Criterion B.

Figure F 3.29: Because the underground workings in uranium mines are dry, they offer an excellent preservation environment for important and perishable artifact assemblages, such as these empty cardboard dynamite boxes that date to the late 1950s. Mines with such workings may be eligible under Criterion D for their information potential. Source: Author.

Figure F 3.30: Underground workings can offer features important to the understanding of mining practices. These blast-holes were drilled in a specific pattern designed to maximize the explosive force of dynamite charges, when inserted. The holes are currently empty. Source: Author.

Most tunnel mines will probably not be eligible under Criterion C because they are common, tend to possess limited integrity, and offer few important characteristics and attributes. However, if an organization pattern is clearly evident or structures and machinery are present, then the resource may be eligible under Criterion C. In general, intact structures and machinery are uncommon and important representations of engineering and technology. Tunnel mines can be eligible under Criterion C if the resource clearly represents the application of engineering, technology, and methods during a given Period of Significance.

Few small mines will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist, especially at large mines. If the resource possesses building platforms and privy pits, testing and excavation of associated buried archaeological deposits may reveal information regarding uranium miners' lifestyles, social structures, and the workplace. Little is currently known regarding these important arenas of inquiry because they received scant coverage in archival sources. As a result, archaeological investigations will be one of the most important means of addressing research questions.

Accessible and intact underground workings are an important source of information regarding the work environment, engineering, and practices that lay hidden beneath the surface. Currently, historical documentation is the principal body of information that researchers rely on for studying the above aspects of mining. Detailed studies of underground structures, machinery, and artifacts at large mines can contribute vital information found nowhere else.

Most small tunnel mines less than 50 years old will not be eligible under Criterion G because they are not important enough to qualify. However, large mines may be eligible because their high volumes of production were important and direct contributions to the nation's nuclear capabilities. In such cases, a site should date to one of the uranium industry's last two Periods of Significance and be a well-preserved example of a tunnel mine.

Inclined Tunnel Mine: As a Property Subtype, inclined tunnel mines tend to be common, and most range in age from the 1950s into the early 1980s. Because inclined tunnel mines usually lacked structures and the equipment was portable, the physical integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation. Sound examples of inclined tunnel mines are uncommon, and those with engineering or architectural features are relatively rare. For an inclined tunnel mine to be eligible, it must possess integrity relative to one of the uranium industry's Periods of Significance.

A few of the seven aspects of historical integrity defined by the NRHP are valid for inclined tunnel mines. While standing structures and intact machinery are rare, the aspect of Location applies to them in the same way as at the Property Subtypes discussed above. For a resource to retain integrity of Design, the resource's material remains must convey the mine's organization, planning, and engineering. Most inclined tunnel mines featured simple surface facilities because they relied on earthmoving equipment and portable machinery for their needs. The aspect of Design might offer large-scale features such as bulldozed rock piles, depressed ore loading areas, and collections of vehicle artifacts where workers serviced the equipment.

The aspect of Setting refers to the area surrounding the resource and whether that area conveys a sense of mining or the environment of when the mine operated. The setting may possess natural qualities or constitute a cultural landscape. To retain integrity, both the Setting and the resource itself must not have changed a great degree from their Period of Significance. If the resource is isolated, then the natural landscape should be preserved. If the resource lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. It must be remembered that the uranium industry used bulldozers extensively for preparation and sample drilling. As a result, bulldozed roads and clearings are often contributing elements of the setting around mine sites.

The aspect of Feeling refers to a resource's ability to imbue today's visitors with a sense of the past and mining history. To retain integrity of Feeling, the resource should possess tangible manifestations, intact features, and lie in an undisturbed setting.

The aspect of Association refers to a resource's ability to clearly represent an inclined tunnel mine. In sum, a researcher should be able to examine a site's physical remains and reconstruct the mining operation in a virtual sense. This requires the resource to retain an intact assemblage of archaeological features and artifacts at the least.

In addition to possessing integrity, inclined tunnel mines must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one of the areas of significance noted in Subsection Feature 3.2 (above), as well as events, trends, and themes important to the uranium mining industry.

Inclined tunnel mines may be eligible under Criterion B if they were clearly associated with an important person. Few inclined tunnel mines, however, are expected to be eligible under Criterion B. Most were small, relatively unimportant, and tended not to draw people of note.

Most inclined tunnel mines will probably not be eligible under Criterion C. They were among the most common types of uranium mines, and inclined tunnel mines usually possess limited integrity and poorly defined feature- and artifact assemblages. However, if a design is clearly evident or if structures and machinery are present, then the resource may be eligible under Criterion C. In general, a site must be a sound example of an inclined tunnel mine, and the features and artifacts should represent the application of engineering, technology, and methods during a Period of Significance.

Few inclined tunnel mines will be eligible under Criterion D because key information usually can be collected by detailed recordation of surface features. Most resources lack buried archaeological deposits of importance. In addition, because the underground workings tend to be shallow and simple, they are unlikely to offer engineering features or artifact assemblages of importance. Exceptions may exist for buried deposits and underground workings at large and well-developed mines.

Most inclined tunnel mines less than 50 years old will be ineligible under Criterion G because they are not important enough to qualify. However, large mines may be eligible because their high volumes of production were important and direct contributions to the nation's nuclear capabilities. In such cases, a site should date to one of the uranium industry's last two Periods of Significance and be a well-preserved example of an inclined tunnel mine.

Inclined Shaft Mine: As a Property Subtype, inclined shaft mines tend to be common and range in age from the late 1910s to the early 1980s. Because structures and equipment were usually removed when the mines were abandoned, the physical integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation. Examples retaining high degrees of archaeological integrity are uncommon, and those with engineering or architectural features are relatively rare. For an inclined shaft mine to be eligible, it must possess integrity relative to one of the uranium industry's Periods of Significance.

Many of the seven aspects of historical integrity defined by the NRHP are valid for inclined shaft mines. The aspect of Location applies to standing structures and intact machinery, which may be encountered at large and complex mines. Standing structures and intact machinery are often important and can contribute greatly to a resource's integrity, but to do so, they must be in their original places of installation. As discussed with the Property Subtypes above, portable equipment can retain the integrity of Location if it lies within the general area of use to the uranium industry.

For an inclined shaft mine to retain integrity of Design, the resource's material remains must convey the mine's organization, planning, and engineering. Inclined shaft mines were often worked periodically and the surface facilities changed by the new operators, leaving evidence of sequential occupation. In such cases, a resource can retain integrity of Design if the material remains reflect the evolution of the surface facilities over time. By studying archival information and material evidence, the researcher can establish a chronology for the resource's evolution. It must be remembered that most resources lack intact structures and equipment, and that archaeological features and artifacts can sufficiently constitute integrity of Design.

The aspect of Setting refers to the area surrounding the resource and whether that area conveys a sense of mining or the environment of when the mine operated. The setting may possess natural qualities or constitute a cultural landscape. To retain integrity, both the Setting and the resource itself must not have changed a great degree from their Period of Significance. The removal of structures and machinery are an exception. If the resource is isolated, then the natural landscape should be preserved. If the resource lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. It must be remembered that the uranium industry used bulldozers extensively for site preparation and sample drilling. As a result, bulldozed roads and clearings are often contributing elements of the setting around mine sites.

The aspect of Feeling refers to a resource's ability to imbue today's visitors with a sense of the past and mining history. To retain integrity of Feeling, the resource should possess tangible manifestations, intact features, and lie in an undisturbed setting.

The aspect of Association refers to a resource's ability to clearly represent a specific type of mine. In sum, a researcher should be able to examine a site's physical remains and reconstruct the mining operation in a virtual sense. This requires the resource to retain an intact assemblage of archaeological features and artifacts at the least. Intact structures and equipment are important additions.

In addition to possessing integrity, mine sites must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one of the areas of significance noted in Subsection F 3.2 (above), as well as events, trends, and themes important to the uranium mining industry. Large mines are likely to be associated with important trends and events because of their high volumes of production and numerous workers.

Inclined shaft mines may be eligible under Criterion B if they were clearly associated with an important person. Some mines, especially large complexes, may be traced to important individuals such as engineers, and in these cases, they can be eligible under Criterion B. The individual must have either been on-site for an appreciable amount of time or played a fundamental and direct role in its physical development. It should be noted that an important person's investment in a property or involvement with a company is too indirect an association for Criterion B. Most sites will not be eligible under the Criterion because proving the direct presence of an important person is unlikely.

Most small inclined shaft mines will probably not be eligible under Criterion C because they are common, tend to possess limited integrity, and offer few important characteristics and attributes. However, if an engineering pattern is clearly evident and the site is a well-preserved example, then it may be eligible under Criterion C. It should be remembered that a sound assemblage of archaeological features and artifacts constitutes integrity. At small mines, the archaeological evidence must clearly represent the hoisting system, compressor location, ore bin, and buildings. If intact structures and machinery are present, the resource may be eligible because these aspects are uncommon and important representations of engineering and technology. Large inclined shaft mines are less common and tend to offer greater numbers of features and artifacts. Even if some of those features possess limited integrity, the overall site may still be eligible if the broad pattern of design and operation is soundly represented. In general, a site's features and artifacts must represent engineering, technology, and operation during a Period of Significance.

Few small inclined shaft mines will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist, especially at large mines. If the resource possesses building platforms and privy pits, testing and excavation of associated buried archaeological deposits may reveal information regarding uranium miners' lifestyles, social structures, and the workplace. Little is currently known regarding these important arenas of inquiry because they received scant coverage in archival sources. As a result, archaeological investigations will be one of the most important means of addressing research questions.

Accessible and intact underground workings are an important source of information regarding the work environment, engineering, and practices concealed beneath the surface. Currently, historical documentation is the principal body of information that researchers rely on for studying the above aspects of mining. Detailed studies of underground structures, machinery, and artifacts at large mines can contribute vital information found nowhere else.

Most small inclined shaft mines less than 50 years old will not be eligible under Criterion G because they are not important enough to qualify. However, large mines may be eligible because their high volumes of production were important and direct contributions to the nation’s nuclear capabilities. In such cases, a site should date to one of the uranium industry’s last two Periods of Significance and be a well-preserved example of an inclined shaft mine.

Vertical Shaft Mine: As a Property Subtype, vertical shaft mines are rare and can range in age from the 1910s into the early 1980s. Because structures and equipment were usually removed when the mines were abandoned, the physical integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation. Examples retaining high degrees of archaeological integrity are uncommon, and those with engineering or architectural features are very rare. For a vertical shaft mine to be eligible, it must possess integrity relative to one of the uranium industry’s Periods of Significance.

Many of the seven aspects of historical integrity defined by the NRHP are valid for vertical shaft mines. The aspect of Location applies to standing structures and intact machinery, which may still exist at large and complex mines. Standing structures and intact machinery are often important and can contribute greatly to a resource’s integrity, but to do so, they must be in their original places of installation. The aspect of Location for portable equipment is the same as discussed with the Property Subtypes above.

For a vertical shaft mine to retain integrity of Design, the resource’s material remains must convey the mine’s organization, planning, and engineering. This will emphasize hoisting and ore handling systems at vertical shaft mines. Often, different operators worked the mines on a periodic basis and incorporated new machinery and structures into the surface facilities, leaving evidence of sequential occupation. In such cases, a resource can retain integrity of Design if the material remains reflect the evolution of the surface facilities over time. By studying archival information and material evidence, the researcher can establish a chronology for the resource’s evolution. It must be remembered that most resources lack intact structures and equipment, and that archaeological features and artifacts can sufficiently constitute integrity of Design.

The aspect of Setting refers to the area surrounding the resource and whether that area conveys a sense of mining or the environment of when the mine operated. The setting may possess natural qualities or constitute a cultural landscape. To retain integrity, both the Setting and the resource itself must not have changed a great degree from their Period of Significance. The removal of structures and machinery are an exception. If the resource is isolated, then the natural landscape should be preserved. If the resource lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. It must be remembered that the uranium industry used bulldozers extensively for preparation and sample drilling. As a result, bulldozed roads and clearings are often contributing elements of the setting around mine sites.

The aspect of Feeling refers to a resource's ability to imbue today's visitors with a sense of the past and mining history. To retain integrity of Feeling, the resource should possess tangible manifestations, intact features, and lie in an undisturbed setting.

The aspect of Association refers to a resource's ability to clearly represent a vertical shaft mine. In sum, a researcher should be able to examine a site's physical remains and reconstruct the mining operation in a virtual sense. This requires the resource to retain an intact assemblage of archaeological features and artifacts at the least. Intact structures and equipment are important additions.

In addition to possessing integrity, a site must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one of the areas of significance noted in Subsection F 3.2 (above), as well as events and trends important to the uranium mining industry. Large mines tend to hold a stronger association with important events and trends because of their voluminous production and numerous workers.

Vertical shaft mines may be eligible under Criterion B if they were clearly associated with an important person. Some large complexes can be traced to important individuals such as engineers, and in these cases, they can be eligible under Criterion B. The individual must have either been on-site for an appreciable amount of time or played a fundamental and direct role in its physical development. It should be noted that an important person's investment in a property or involvement with a company is too indirect an association for Criterion B.

Most small vertical shaft mines will probably not be eligible under Criterion C because they usually possess impaired integrity and poor feature- and artifact assemblages. However, if the design is clearly evident and the site is a sound example, then the resource may be eligible under Criterion C. It must be remembered that a complete assemblage of archaeological features constitutes integrity. Those features should clearly represent the hoisting system, compressor location, ore bin, and buildings. Large, vertical shaft mines tend to offer greater numbers of features and artifacts. Even if some of those features possess limited integrity, the overall site may still be eligible if the broad pattern of design and operation is soundly represented. It should be noted that intact structures and machinery are uncommon representations of engineering and technology, and they are usually important contributing elements of physical integrity. In general, a site's features and artifacts must represent engineering, technology, and operation during a Period of Significance.

Few small mines will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist, especially at large mines. If the resource possesses building platforms and privy pits, testing and excavation of associated buried archaeological deposits may reveal information regarding uranium miners' lifestyles, social structures, and the workplace. Little is currently known regarding these important arenas of inquiry because they received scant coverage in archival sources. As a result, archaeological investigations will be one of the most important means of addressing research questions.

Accessible and intact underground workings are an important source of information regarding the work environment, engineering, and practices that lay hidden beneath the surface. Currently, historical documentation is the principal body of information that researchers rely on for studying the above aspects of mining. Detailed studies of underground structures, machinery, and artifacts at large mines can contribute vital information found nowhere else.

Large vertical shaft mines less than 50 years old hold a high potential for eligibility under Criterion G. Such sites tend to be distinct and feature evidence of permanent machinery, formal engineering, and substantial structures. By producing great tonnages of ore, the large mines rendered important and direct contributions to the nation's nuclear capabilities. To be eligible, a site must date to one of the uranium industry's last two Periods of Significance and exemplify a vertical shaft mine.

Open-Cut Mine: As a Property Subtype, open-cut mines are the least common and can range in age from the late 1890s into the early 1980s. Because most open-cut mines lacked structures, and the equipment was usually removed when a site was abandoned, the physical integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation. Examples retaining high degrees of archaeological integrity are uncommon, and those with engineering or architectural features are very rare. For an open-cut mine to be eligible, it must possess integrity relative to one of the uranium industry's Periods of Significance.

Only a few of the seven aspects of historical integrity defined by the NRHP are valid for open-cut mines. The aspect of Location is unlikely to be relevant because few mines possessed structures. Portable machinery may exist at a few sites, in which case its integrity of Location should be limited to the general area around the mine.

The aspect of Design will have limited application to open-cut mines. In general, mining outfits removed the ore as they encountered it and engaged in little planning and development. As a result, the workings often followed no formal engineering. The aspect of Design will apply mostly to the transportation systems used to haul away waste rock and shuttle ore to a storage and transfer structure. Because most resources lacked structures and relied on portable equipment, archaeological features and artifacts will usually constitute integrity of Design.

The aspect of Setting refers to whether the area surrounding the resource conveys a sense of mining or the environment of when the mine operated. The setting may possess natural qualities or constitute a cultural landscape. To retain integrity, both the Setting and the resource itself must not have changed a great degree from their Period of Significance. The removal of structures and machinery are an exception. If the resource is isolated, then the natural landscape should be preserved. If the resource lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. It must be remembered that the uranium industry used bulldozers extensively for preparation and sample drilling. As a result, bulldozed roads and clearings are often contributing elements of the setting around mine sites.

The aspect of Feeling refers to a resource's ability to imbue today's visitors with a sense of the past and mining history. To retain integrity of Feeling, the resource should possess tangible manifestations, intact features, and lie in an undisturbed setting.

The aspect of Association refers to a resource's ability to clearly represent an open-cut mine. In sum, a researcher should be able to examine a site's physical remains and reconstruct the mining operation in a virtual sense. This requires the resource to retain an intact assemblage of archaeological features and artifacts at the least. Intact structures and equipment are important additions.

In addition to possessing integrity, mine sites must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one of the areas of significance noted in Subsection Feature 3.2 (above), as well as events, trends, and themes important to the uranium mining industry.

Open-cut mines may be eligible under Criterion B if they were clearly associated with an important person. Most sites, however, are unlikely to be eligible under the Criterion. Because open-cut mining was technologically simple, it rarely involved important engineers and geologists. In addition, archival sources offer poor coverage of surface mining, and so confirming the presence of important persons is difficult.

Most open-cut mines will probably not be eligible under Criterion C because they usually retain poor integrity, offer few important characteristics and attributes, and are not outstanding examples of surface operations. If intact structures and machinery are present, and if the workings are well-preserved, then the resource may be eligible because these aspects are uncommon and important representations of the most elementary form of uranium mining. The features and artifacts must represent the application of engineering, technology, and operation during a Period of Significance.

Few open-cut mines will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Most sites lack buried archaeological deposits or underground workings of importance.

Most open-cut mines less than 50 years old will not be eligible under Criterion G because they are not important enough to qualify. However, a site may be eligible if it meets several conditions. First, the site should date to one of the uranium industry's last two Periods of Significance. Second, the site must be a well-preserved example of an open-cut mine. Third, the mine must have been noteworthy in of itself when active, or been a component of a substantial operation involving several other mines.

F 4: PROPERTY TYPE: ORE CONCENTRATION FACILITY

One of the main objectives of uranium and vanadium mining was to reduce carnotite and roscoelite ores to their constituent metals. In general, the process began with crushing and grinding the ore, followed by separating metalliferous material from waste in a stage known as concentration. The resultant redcake (vanadium) went to steel mills for use as an alloy material. During the 1900s and 1910s, private companies extracted radium from the yellowcake (uranium) for medical and industrial uses. Beginning in World War II, the Federal Government took charge of the yellowcake and enriched it for weapons and nuclear power plants in tightly controlled facilities. *Concentration mills*, also known as uranium and vanadium mills, completed the crushing and concentration steps.

As a Property Type, ore concentration facilities include only one type of resource, which is the concentration mill. The reason is that, even though uranium and vanadium mills differed in size and complexity, they shared the purpose of producing yellowcake, redcake, or both. Further, nearly all employed variations of the same basic processes. The National Radium Institute mill and its 1916 incarnation at the Tramp Mine are the principal exceptions, and even these facilities generated a form of carnotite concentrates.

F 4.1: Ore Concentration Facility Subtypes

Concentration Mill: A concentration mill was a facility that employed mechanical and chemical methods to recover vanadium and uranium compounds from ore. The mills around the Placerville area, San Miguel County, were specifically designed to recover vanadium from roscoelite ore. The mills elsewhere in western Montrose and San Miguel counties were engineered to recover vanadium and uranium from carnotite ore. As noted above, mills came in a variety of scales. The early mills tended to be small and feature several stages of crushing and concentration in a single, linear path. The later mills tended to be large and heavily equipped to process both high volumes of ore, and low-grade ore that required multiple treatment stages. To do so, they provided primary, secondary, and even tertiary crushing, screening between each apparatus, multiple concentration steps, and several parallel sequences.

As a resource type, vanadium and uranium concentration mill sites are important and rare on local, statewide, and national levels. To be classified as a concentration mill site, a historic resource need be merely the place where a mill existed. Mill sites are not expected to possess standing buildings and intact machinery, and the Gateway Alloys Mill at Gateway is the only one in the region known to be relatively intact. Some of the other mills in the Uravan Mineral Belt have been reduced to foundations and terraces, but most were lost to salvage efforts, environmental remediation projects, alteration, and natural decay. Given this, sites that retain integrity only on an archaeological level are rare.

Features Common to Ore Concentration Mill Sites

Mill sites can possess an array of archaeological, engineering, and architectural features that were components of crushing, ore concentration, power, and infrastructure systems. To help researchers identify the components and organize their data, the Feature Types below are arranged according to the general flow path employed at mills.

General Feature Types

Air Compressor Foundation: Some ore concentration processes and mill equipment relied on compressed air. To provide this, most mills featured at least one stationary air compressor, usually on one of the main terraces. The types of compressors and their foundations were identical to those at mines, discussed above.

Assay Shop Platform: Mills often featured assay shops in which an assayer tested the mineral content of ore samples. In most cases, this was done to track the efficiency of a mill's concentration processes. In some mills, the shop was within the mill building, and in other instances it was an independent building on an earthen platform. An assay shop platform can be identified by the scorched remnants of an assay furnace, as well as clinker, bricks, assay crucibles, and laboratory artifacts.

Bulldozed Area: Mill sites commonly feature areas bulldozed for various purposes such as vehicle parking, maneuvering trucks, and storing materials.

Cistern: A concrete, masonry, or timber chamber that contained water for mill use. Because mills usually relied on gravity to pressurize plumbing, cisterns tend to be located upslope from a mill.

Conveyor: Conveyors lifted ore from one process to another. Early conveyors were bucket-lines or spiral-feeds while later conveyors consisted of belts on rollers.

Conveyor Remnant: A partially disassembled conveyor.

Ditch: An excavation that carried water to a mill.

Flume: A wooden structure usually constructed with plank walls and a plank floor. Workers built flumes to convey water to or tailings away from a mill, and to transfer slurry from one process to another.

Flume Remnant: The collapsed or buried remnants of a flume.

Forge: Shops at mills featured the same types of forges as at mines.

Forge Remnant: Collapsed forges are like those at mine sites, discussed above.

Grizzly: Mills employed the same types of grizzlies at mines.

Holding Bin: Holding bins contained ore between crushing or processing stages. A conveyer usually dumped material into the top, and a chute meted the material out the bottom. Holding bins were usually sloped- or pyramid-floor structures amid a mill's terraces.

Holding Bin Ruin: Collapsed or partially dismantled holding bins can manifest as the subframe, the sloped floor, or partial walls.

Laboratory: Because treating uranium ore was a complex and chemical-intensive process, nearly all mills featured laboratories. In the facility, a chemist assayed ore, analyzed chemicals, tested process effectiveness, and experimented with chemical reactions. Some laboratories were within the mill building while others were independent.

Laboratory Foundation: A foundation that supported a laboratory. The associated artifact assemblage should include laboratory ware, ore samples, and assay refuse.

Laboratory Platform: A platform that supported a laboratory building.

Loading Dock: Loading docks were ramps that allowed workers to unload heavy equipment and supplies from trucks. Loading docks usually feature retaining walls.

Machine Foundation: A foundation that anchored an unknown mill machine.

Mill Building: The structure that enclosed a mill. Mill buildings tended to be large, based on stout frames, and conformed to stairstep terraces or foundations.

Mill Building Ruin: A collapsed mill building.

Mill Platform: One of the main platforms or flat areas that supported a stage of crushing or concentration. When recorded, platforms should be numbered from the top down and described according to function.

Mill Tailings Dump: A deposit of finely ground rock flour and sand usually downslope or downstream from a mill. Tailings were the unwanted end-product of concentration processes.

Mill Tailings Ponds: By the 1930s, milling companies were required to construct dry ponds to impound their tailings. The ponds often featured earthen dams and tailings.

Office: Nearly all mills featured an office where management planned facilities and administered operations. Offices often had electricity and telephones, and some were attached to a laboratory. Artifact assemblages are expected to be light and include electrical hardware.

Office Platform: A platform on which an office building stood.

Parking Area: Many mills featured bulldozed areas dedicated to vehicle parking and maintenance. Parking areas usually feature high proportions of vehicle-related artifacts generated during repair and maintenance.

Pipeline: An assembly of pipes that carried water.

Pipeline Remnant: The evidence left by a disassembled pipeline.

Privy: Most mill complexes included a privy for the crew's personal use.

Privy Pit: The pit that underlay a privy. Privy pits are often less than 5 feet in diameter and may feature artifacts visible in the walls and floor. Privy pits often possess important, buried deposits.

Pump Foundation: Often of concrete, pump foundations are rectangular, less than 2 by 4 feet in area, and may feature input and outlet pipes.

Receiving Bin: Most mills featured an ore bin at the head to receive crude ore delivered for processing. Receiving bins were usually sloped-floor structures that fed the crude ore into the mill's primary crusher. Because of this function, they were elevated and featured unloading chutes in the front bottom.

Receiving Bin Platform or Foundation: Receiving bins stood on foundations and platforms that supported their subframes. The foundations often consist of log or timber pilings and concrete footers, and the platforms are usually stairstep pads retained by log cribbing.
Receiving Bin Ruin: Collapsed or partially dismantled receiving bins can manifest as the subframe, the sloped floor, or partial walls.
Refuse Dump: A refuse dump is a concentration of cast-off hardware, structural materials, and domestic waste in a single location.
Refuse Scatter: In contrast to a dump, a refuse scatter is a disbursed assemblage of hardware, structural debris, and domestic rubbish.
Reservoir: Some milling operations erected dams in drainages to impound water for use.
Shop: Most mills featured shop facilities for the manufacture and repair of tools, hardware, and machinery. Nearly all shops included blacksmith and machining facilities, and some were equipped for carpentry.
Shop Platform: The platform that supported a shop. An artifact assemblage including forge clinker, pieces of hardware, forge-cut iron scraps, cut pipe scraps, and cut wood scraps can help identify a shop platform.
Shop Ruin: The collapsed remains of a shop.
Shop Refuse Dump: A deposit or scatter of forge clinker, forge-cut iron scraps, cut pipe scraps, and pieces of hardware. Carpentry shops left an abundance of cut wood scraps, sawdust, and hardware.
Structure Platform: An area leveled for an unknown structure. If the structure type is known, then the feature type should specify. Structural debris usually denotes the presence of a structure.
Tank: A tank was a vessel for the storage of liquid, which was usually water at mill sites. Prior to the 1940s, most tanks were made of riveted steel or wooden staves, and afterward, they were welded together. To pressurize plumbing, water tanks were usually located near the head of a mill.
Tank Foundation: Tanks at mills often stood on concrete or timber foundations.
Tank Platform: An earthen platform that supported a tank. Timber bolsters and outlet pipes often remain.
Transformer House: A transformer house was a small, frame building that enclosed a transformer station. The building usually featured insulators, a utility pole, and electrical artifacts.
Transformer House Platform: A platform that supported a transformer house. The artifact assemblage should include a high proportion of electrical items.
Transformer House Ruin: The collapsed remnants of a transformer house.
Transformer Station: Nearly all mills that postdate the 1910s were equipped with electricity for lighting and power. Transformer stations converted the electricity to applicable voltage and amperage. The stations featured incoming power lines, transformers, and distribution lines to the mill facilities. Plank pallets suspended

between two utility poles usually supported the transformers. Electricians usually isolated the station in case of fire.
Trestle: A structure that supported a truck runway, a conveyor, or a pipeline.
Trestle Remnant: Posts, single piers, or partial stringers left from a trestle.
Utility Pole: A pole that carried electrical or telephone lines.

Crushing System Feature Types

Jaw Crusher: A mill apparatus located on the mill's upper terrace that pulverized crude ore into gravel. Crushers usually featured jaws and dual flywheels powered by a belt. Small units were around 2 by 4 feet in area and large units were up to 4 by 8 feet in area.
Crusher Foundation: Due to severe vibrations, crushers were often anchored to stout timber or masonry foundations. Small piles of crushed gravel often underlie crusher foundations.
Stamp Battery: A stamp battery consisted of a heavy timber gallows frame, stamps that dropped into a battery box, and a cam shaft that raised and then let the stamps drop. The timber frame for a single group tended to be 7 feet wide, up to 15 feet high, and stood over a cast-iron battery box bolted to a timber pedestal. The frame featured guides for the stamps and a cam shaft fitted with a large bull wheel.
Stamp Battery Frame: In many cases, salvage efforts dismantled the iron hardware from a stamp battery, leaving only the frame.
Stamp Battery Pedestal: Often, stamp mills were removed in entirety for use elsewhere, leaving only the underlying pedestal. Usually made of timbers on-end, the pedestal anchored a cast-iron battery box in which the stamps dropped and crushed the ore. Pedestals were rectangular, around 2 by 5 feet in area, and 2 feet high.
Screening Station: Screens, often cylindrical trommels, were usually located below each crushing stage and classified pulverized ore by particle size.

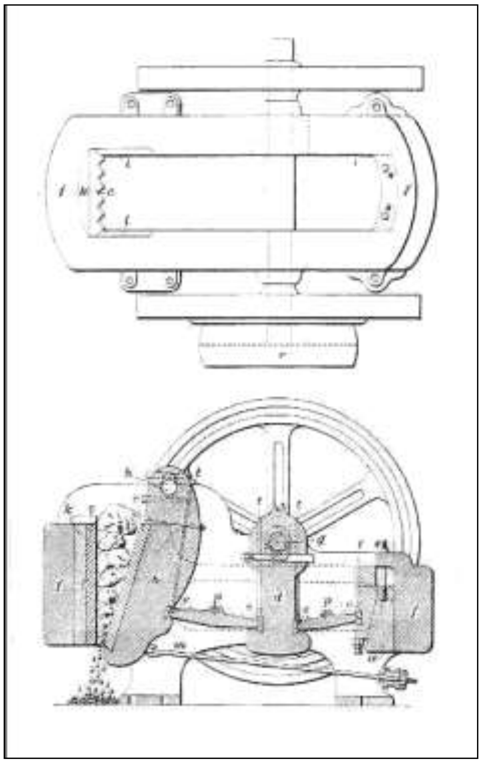


Figure F 4.1: The plan view, top, and profile, bottom, illustrate a jaw crusher, which provided initial crushing at most mills. Source: International Textbook Company, 1899, A43:2.

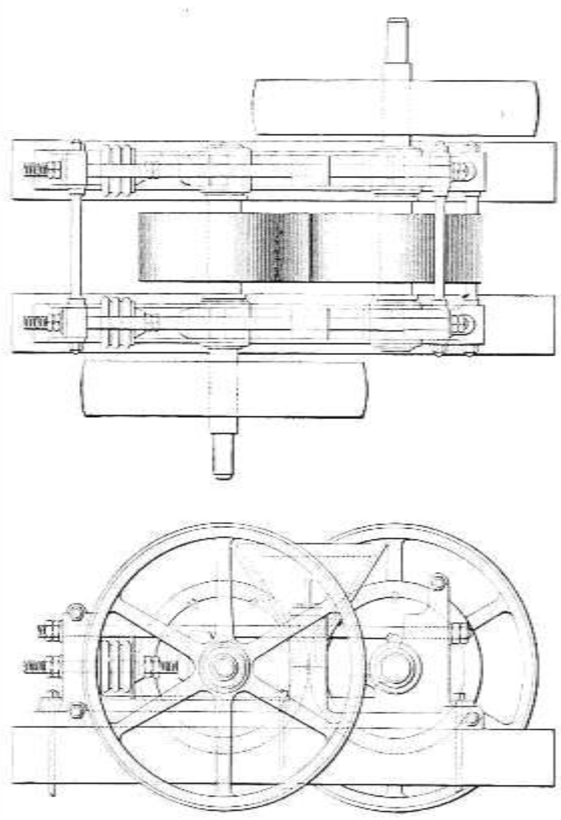


Figure F 4.2: The plan view, top, and profile, bottom, illustrate a device known as a crushing rolls, which was popular for secondary and tertiary crushing. Source: International Textbook Company, 1899, A43:12.

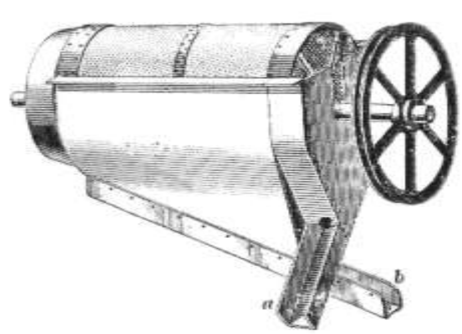


Figure F 4.3: Most mills relied on trommel screens to sort crushed rock between processing stages. Source: International Textbook Company, 1899, A43:12.

Figure F 4.4: Rod mills were occasionally used for find grinding. As the entire cylinder slowly rotated, tumbling steel rods in the chamber ground screened ore into a slurry. A hatch covered the opening. Source: Carol Beam.

Crushing Rolls: A crushing rolls was an apparatus that provided secondary or tertiary crushing for ore already reduced to gravel. The apparatus featured a pair of large iron rollers set slightly apart in a cast-iron or heavy timber frame. As they rotated, the rollers drew gravel into the gap and fractured it. Small units were around 4 by 4 feet in area while common units were 6 by 6 feet in area. Crushing rolls were usually located on an upper mill terrace below the primary crusher.

Crushing Rolls Foundation: Crushing rolls were often anchored to a rectangular timber foundation consisting of heavy, horizontal beams bolted to posts that leaned slightly inward.

Ball Mill: A ball mill was an apparatus that ground previously crushed ore and mixed it with water to form a slurry. The machine featured a conical tumbler that rotated horizontally on heavy axles, one of which featured a drive-gear. Different size mills were available, and small tumblers were at least 3 feet in diameter and 6 to 7 feet long. As the tumbler slowly rotated, steel balls inside collided and ground the ore.

Ball Mill Foundation: Because of their great weight and powerful vibrations, ball mills were anchored to heavy concrete pylons usually 8 feet apart. The main pylon was L-shaped, 1 foot thick, at least 3 feet high, and anchored an axle bearing and gearing. The second pylon was usually at least 4 feet high and 4 feet long.

Rod Mill: A rod mill was similar to a ball mill and served the same function. The machine featured a cylindrical tumbler that rotated horizontally on heavy axles, one of which featured a drive-gear. Different size mills were available, and small tumblers were at least 3 feet in diameter and 6 to 7 feet long. As the tumbler slowly rotated, steel rods inside collided and ground the ore.

Rod Mill Foundation: Rod mills were anchored to heavy concrete pylons usually 8 feet apart. The main pylon was at least 1 foot thick, 4 feet wide, and 3 feet high, and anchored an axle bearing. The second pylon was usually at least 4 feet high and 4 feet long. A separate pad anchored the drive motor.

Concentration System Feature Types

Jig: A jig was an appliance that enhanced the separation of metalliferous particles from waste. The common jig consisted of a wood body with a V-shaped bottom that featured drain ports and wood walls dividing the interior into cells. Most tended to be around 4 by 9 feet in area and 4 feet high. Plungers in the cells created water currents that caused heavy particles to settle and kept light waste suspended, which was then washed away. Jigs may have been used between the 1900s and 1910s, when ore treatment was in an experimental state.

Vibrating Table: A vibrating table was an apparatus that used mechanical action to separate light waste from heavy metalliferous particles. The vibrating table featured a slanted tabletop, often 5 by 15 feet in area, clad with rubber and narrow wooden riffles. Tabletops were often mounted at a slant on a mobile iron frame set in motion by an eccentric camp. Vibrating tables may have been used between the 1900s and 1910s, when ore treatment was in an experimental state.

Vibrating Table Foundation: Vibrating table foundations featured six pairs of anchor bolts projecting out of three timber footers totaling around 12 to 15 feet in length.

Roasting Furnace: By the 1910s, most uranium and vanadium mills featured furnaces in which ore was roasted with salt prior to concentration. This step prepared the uranium and vanadium for leaching. Early furnaces were brick structures located on one of a mill’s middle terraces, above the leaching platforms.

Roasting Furnace Foundation: A square or rectangular pad of bricks or rocks that supported a roasting furnace.

Rotary Kiln: By the 1940s, milling companies used rotary kilns to roast ore prior to leaching because kilns were superior to stationary furnaces. A kiln featured a long steel cylinder that slowly revolved. Crushed ore trickled in from a chute at the top, was subjected to great heat in the cylinder, and poured out the bottom in a continuous flow. The cylinder slanted gently to facilitate the flow of ore, and it was powered by a large motor and gearing.

Rotary Kiln Foundation: Rotary kiln foundations featured a series of concrete footers that supported the end bearings and center supports. Each footer was at least 1 foot thick, 4 feet long, and 4 feet high. The head footer had additional concrete pads for the gearing and motor.

Leaching Tank: Leaching was one of the most important steps in uranium and vanadium ore concentration. In the process, acidic and basic solutions leached uranium and vanadium out of roasted and ground ore. Leaching tanks contained the solutions, and they usually stood on a mill's lower terraces. The tanks were made of materials that resisted corrosion. Large mills usually featured several batteries of tanks for multiple leaching stages.

Precipitation Tank: After the ground ore had been subjected to the leaching solution for a prescribed amount of time, the solution was tapped into precipitation tanks, which stood on a mill's lowest terraces. Workers introduced alkaline chemicals into the tanks, which caused the uranium and vanadium to precipitate out of the solution. The results, yellowcake and redcake, were collected and dried, and the depleted solution was piped into another battery of precipitation tanks for fine recovery. When fully exhausted, the solution was recharged for reuse.

Settling Tank: Advanced concentration mills incorporated settling tanks into their separation processes, and the tanks stood on the lower platforms. In the tanks, revolving arms at center caused heavy metalliferous fines to gravitate out of spent slurry, while light waste remained in suspension at the top. The metalliferous material was recovered and leached a second time. Settling tanks were similar to wooden water tanks with revolving arms at center.

Drying Kiln: Advanced mills featured small kilns on the bottom terraces in which redcake and yellowcake were dried for shipment. The kilns could have been stationary brick vaults or rotary units, and both featured adjacent blowers that forced hot air in.

Drying Kiln Foundation: Brick pads supported stationary drying kilns while several, elongated concrete piers anchored short, rotary units.

Boiler: Some of the small, early mills were powered by steam engines, and boilers provided the engines with steam. At the small mills, the boilers could have been locomotive or upright units. During the 1910s and 1930s, large mills employed stationary return-tube boilers. These are discussed under mine feature types.

Boiler Foundation: See mine feature types.

Boiler Setting Ruin: See mine feature types.

Boiler Clinker Dump: See mine feature types.

Gasoline Engine: Gasoline engines were used to power small mills, and groups of machines at large mills. Upright single-cylinder models saw popularity through the 1910s, and inline six and eight cylinder engines predominated after.

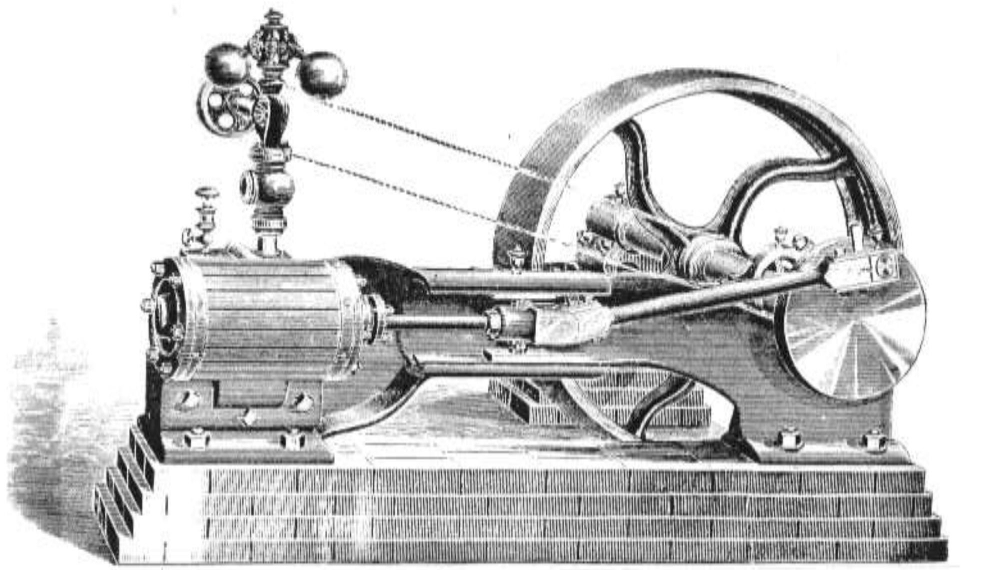


Figure F 4.5: Until electricity was available, horizontal steam engines powered mill machinery. A drive belt passed around the flywheel to a mill's system of driveshafts. Note the masonry foundation. Source: Ingersoll Rockdrill Company, 1887:53.

Figure F 4.6: When electricity was available by the 1940s, companies used electric motors to power their mills. Source: Carol Beam.

Gasoline Engine Foundation: At small mills, gasoline engines were usually bolted to the mill building's stout support frame. Otherwise, engines were usually bolted to a steel chassis that was pinned down to one of the mill's concrete floors.
Motor: By the 1930s, motors powered machinery at the principal mills. The common motor consisted of a cylindrical body, a belt pulley, and electrical wiring. Most motors were less than 4 by 5 feet in area.

Motor Foundation: Due to great weight and stresses created by motion, motors were usually anchored to stout concrete or timber foundations. Foundations tend to be slightly rectangular, less than 4 by 5 feet in area, feature four to six anchor bolts, and are aligned with the machine that the motor powered.

Overhead Driveshaft: Sets of overhead driveshafts transferred motion from the engine or motor to the mill appliances. Overhead driveshafts featured belt pulleys over each mill appliance and rotated in bearings usually bolted to the mill building's frame.

Steam Engine: Between the 1900s and 1910s, steam engines were a common source of power for mills. Usually located on the mill's lowest terrace, the engine transferred motion to a system of overhead driveshafts via a canvas belt. Most engines were horizontal units between 2 and 3 feet in width and 8 to 12 feet long. A steam engine required a boiler.

Steam Engine Foundation: Steam engine foundations are often rectangular, studded with anchor bolts, and between 2 and 3 feet in width and 8 to 12 feet long. Workers built engine foundations with heavy timbers, brick or rock masonry, or concrete, and the foundations often featured a pylon for the outboard flywheel bearing.

Transformer Station: See mine feature types.

Transformer Station Platform: See mine feature types.

Transformer Station Remnant: See mine feature types.

F 4.2: Ore Concentration Facility Significance

Ore concentration mills are associated with trends of major importance on local, statewide, national, and worldwide levels. Period of Significance is not as critical for concentration mills as it is for mines. The reason is that the mills were important during all the times that they operated. The uranium and vanadium mining industry was the region's economic and employment foundation even between Periods of Significance. By providing local ore treatment, the mills directly supported the mining industry, which may have otherwise ceased. Through this association, the mills participated in many of the broad trends attributable to the overall mining industry, as discussed under mine Property Types (Subsection Feature 3.2). A sample of broad trends includes contributions to the Manhattan Project, the Cold War nuclear weapons programs, and the nuclear power industry.

When considered by themselves, the mills were major employers and economic contributors. Further, the three mills operated by USV, VCA, and North Continent Mines helped their dependent communities weather the slow periods following World War II.

In addition to the above, concentration mills were associated with other trends that were specific to each of the uranium industry's Periods of Significance. North America's first three uranium mills were built during the first Period (1898-1905). In these mills, metallurgists pioneered the basic processes used to extract uranium, from which they derived radium, and established a technological foundation.

During the second Period (1906-1922), North America's first vanadium mills were built near Placerville, and at the same time, companies such as Standard Chemical improved the existing methods for separating both vanadium and uranium from carnotite ore. Most of the methods became lasting contributions that were applied through the 1950s.

From the mid-1930s through the 1950s, USV, VCA, and North Continent Mines operated most of the mills in western Montrose and San Miguel counties. These companies experimented with improvements to the known ore treatment processes in an effort to recover increasing amounts of uranium and vanadium from their ores. In so doing, the companies contributed to the metallurgy, chemistry, and economics of uranium and vanadium recovery. This directly benefited the mining industry because it rendered grades of ore that were previously uneconomical cost-effective to produce. Low-grade ores carried the mining industry through the 1960s and 1970s.

F 4.3: Ore Concentration Facility Registration Requirements

Vanadium and uranium concentration mill sites are likely candidates for the NRHP and SRHP, but only if they retain integrity at least on an archaeological level. A site's features and artifacts must clearly represent the footprints of the mill building and most of the ancillary structures, and approximate the infrastructure. The features and artifacts must also reflect the overall ore treatment process in a general sense. While each processing stage need not be portrayed in detail, the features should communicate the general flow of ore through the mill, from receiving bin to crushers to furnace and then leaching tanks. At the small, early mills, the features are expected to be inadequate because most of the equipment was bolted to support timbering, which is gone. At the large mills, however, concrete foundations may still remain.

In addition to retaining physical integrity, mill sites must meet one of the NRHP Criteria for eligibility. Sites eligible under Criterion A must be associated with at least one area of significance noted above, or the events and trends that were important during a specific Period of Significance. Because of their fundamental role in the mining industry, most mill sites are associated with numerous events and trends, which the researcher must state.

Of all the uranium mining resource types, mill sites have the highest likelihood of eligibility under Criterion B. The reason is that all were designed by chemists and engineers, and most of these individuals were important in the uranium industry, as well as other arenas. As with the other resource types, mere investment in a facility, or involvement with a milling company, is too indirect an association for eligibility. The individual of note must have either been present at the mill or played a direct and fundamental role in its physical development.

Mill sites will not be eligible under Criterion C unless they retain physical integrity as described above. If the buildings and ore flow-path are represented by archaeological features, then the site may be eligible as an archaeological example of a vanadium or uranium mill. If the site possesses intact structures and machinery, the case for eligibility becomes stronger because these enhance the representation of uranium and vanadium ore treatment engineering and metallurgy. Further, few associated buildings, structures, or pieces of equipment currently exist.

If a mill site possesses a relatively intact assemblage of equipment foundations and terraces, it may be eligible under Criterion D. Intensive documentation and interpretation of the features can contribute to the current knowledge of vanadium and uranium ore treatment processes. The historical processes and specific pieces of equipment used to recover uranium and vanadium are poorly understood at present.

If the site possesses privy pits, boiler clinker dumps, and other buried archaeological deposits, it may be eligible under Criterion D. Testing and excavation may reveal information regarding workers' lifestyles, social structures, and the workplace.

Mill sites less than 50 years old may be eligible under Criterion G because of their importance to the uranium industry's last two Periods of Significance (defined in Section E). By producing yellowcake, the mills directly contributed to the nuclear weapons programs of the early 1960s and the rise of nuclear power during the 1970s.

F 5: PROPERTY TYPE: MINING SETTLEMENT AND RESIDENCE

Most of the uranium mines in western Montrose and San Miguel counties were remote, and great distances separated them from established towns such as Nucla, Naturita, Uravan, Paradox, and Placerville. During the uranium industry's first 60 years, prospectors, miners, and other workers found daily commutes protracted if not impossible, and as a result, they had to live near their points of work. Prospectors established temporary camps in the areas of their searches. Mining companies provided workers' housing in centers of activity such as Long Park, and independent miners provided their own residences at the mines they leased. Where mines and prospects were numerous and closely spaced, workers arranged concentrations of residences that they referred to as mining camps. Some of these camps, such as Uranium in Roc Creek and Long Park Camp in Long Park, evolved into organized settlements with businesses, communication, and public spaces.

During the 1900s and 1910s, almost all miners lived near the operations in which they were employed. Roads were few, automobiles rare and expensive, and the mines difficult to reach, which required that miners commute by foot or horse. Given this, various types of residences can be expected to be near those mines more than several miles from a settlement.

During the 1930s and 1940s, miners were no more likely to commute to their jobs from the distant towns than in previous decades. Economic resources were scarce, automobiles were rare, and the region's roads remained rough, which translated into long drives. As a result, independent miners lived near the properties they leased, but the employees of the large companies had several options. USV and VCA, which operated most of the mines and the region's two mills, provided company housing. USV kept a boardinghouse and single-occupancy houses at Uravan for mill workers and the miners employed on Club Mesa. VCA offered more single-occupancy houses and apartments at Vancorum for its mill workers and a few miners. The miners in both company towns rode trucks and buses up to the mines on Club

Mesa, Bitter Creek, and Long Park. USV and VCA also maintained several camps in Long Park and Carpenter Flats because the commutes from Uravan and Vancorum were too long.

By the 1950s, the region's commute pattern changed, and large numbers of miners began to commute from homes in Nucla, Naturita, and Paradox. Several conditions contributed to the change. The most important factor was the proliferation of affordable automobiles and pickup trucks. Many miners now had their own vehicles. The second was that the AEC invested heavily in the region's road systems, which reduced travel time. The last was a demographic shift away from single miners to workers with families, and they preferred to live in the towns to be near schools, stores, and aspects of community. In general, miners were willing to commute up to one hour away for the luxury of living in town.[7]

But, many of the mines were much farther than an hour's drive, and in such cases, miners chose to live near their places of work. When finances permitted, miners preferred to billet their families in town and visit on weekends, although some families joined the miners in the field. Company housing was less common during the 1950s and 1960s because USV and VCA did not operate their mines and instead leased out the properties. The lessees were usually responsible for providing their own housing, which ranged from temporary, frame cabins, to wall tents, to camp trailers. If a mine was isolated, the lessees stationed their residence in the best adjacent location. If a specific mine or a group of operations employed more than several workers, then the various lessees clustered their residences together in the form a mining camp. Most camps were informal and haphazard, while those established by companies tended to conform to a basic organization pattern.[8]

The commute pattern changed again during the mid-1960s. By this time, western Montrose and San Miguel counties featured a web of well-graded roads, which decreased commute times even more. In addition, automobiles and trucks were increasingly reliable, and miners with families constituted a greater proportion of the workforce. As a result, more miners were willing to commute from town and fewer lived at the mines than before. This trend continued through the 1970s, until on-site residence was relatively rare.

F 5.1: Mining Settlement and Residence Subtypes

Prospector's Camp: When examining areas for ore or developing claims, prospectors usually established impermanent camps. Prospectors' camps of the 1900s and 1910s were simple, usually had wall tents instead of formal buildings, and were abandoned after brief occupation. During the 1950s uranium boom, prospectors also converted abandoned exploratory adits into residences, and they often used camp trailers.

Because prospect camps were intended to be impermanent and were occupied briefly, they often left only the barest of material evidence remaining today. A camp inhabited by one individual or a pair of prospectors tends to be represented by a single tent platform, a sparse scatter of food cans, and little else. If the prospector lived in a trailer, the site may manifest as little more than an open area for the trailer, surrounded by a refuse scatter. Multiple tent platforms and trailer pads often represent prospecting parties. Occasionally, prospectors intending to spend time intensely examining an area

[7] Holland, 2007; McLeroy, 2007.
[8] Chiles, 2007; Davis, 2007; Holland, 2007; McLeroy, 2007.

erected a dugout excavation as a residence. In general, a prospectors' camp should be either directly associated with prospect workings or lie in an area that was subjected to prospecting. If a prospector's camp is actually a component of a greater prospect complex, then the resource would qualify as a Prospect Complex resource type.

Figure F 5.1: During the Cold War boom of the 1950s, prospectors often converted abandoned adits into camp residences. At this adit (5MN8179), on Wedding Bell Mountain, prospectors erected a plank and dry-laid rock wall façade to enclose the interior. Domestic refuse lies around the portal. Source: Author.

Prospectors' Camp Feature Types

Corral: During the 1900s and 1910s, prospectors relied on pack animals to carry their equipment and supplies. They constructed small corrals near their camps to keep the animals, and often used brush and wire for fencing.
Domestic Refuse Scatter: When finished with meals, prospectors usually threw their refuse around their residences, which became disbursed over time. Prospectors' refuse scatters tended to consist of a limited variety of cans, bottles, and other types of domestic refuse.
Fire Hearth: An outdoor ring or rock structure in which prospectors made fires for cooking and heating.
Pack Trail: The traffic from a prospector's camp to areas under examination resulted in the development of pack trails, which are no wider than 7 feet.
Tent Platform: Prospectors often graded small platforms, usually less than 20 by 20 feet in area, for wall tents. In some cases, prospectors placed rocks on the platform's edges or corners to support a tent's wood pallet floor and drove stakes

along the edges to guy the walls. A paucity of structural artifacts, the presence of tarpaper washers, and disbursed domestic artifacts characterize tent platforms.

Trailer Pad: By the 1950s, prospectors often towed trailers to areas of interest and parked them on flat ground in clearings. The prospectors sometimes leveled the trailer with rocks, which may still remain. Trailer pads are almost always surrounded by scatters of domestic refuse, mostly in the form of food cans.

Workers' Housing: Workers' housing refers to the residences and associated features inhabited by uranium industry workers. If a workers' housing complex is directly associated with a mine or mill, then the workers' housing would not be a resource in itself. Instead, it would be part of the larger mine or mill site. Workers' housing may be classified as an independent resource under several conditions: (1) The associated mine or mill has been destroyed, leaving only the residential features. In this case, the lost or damaged industrial complex should be noted with the site description. (2) If workers' housing features cannot be tied to a single industrial complex. For example, residential features may lie near a cluster of mines, and yet be far enough away so that the residential features cannot be attributed to one specific operation.

As a resource type, workers' housing includes all features associated with inhabitation and other domestic activities. Most sites are simple and typically include one or two residence locations, a refuse scatter or dump, and a privy or privy pit. During the 1900s and 1910s, wall tents, frame buildings, portable buildings, and stone cabins served as residences. By the 1950s, little changed regarding workers' housing, although camp trailers replaced the wall tents. Often, workers erected the above residences on platforms and used rocks to level the floors. In addition, the platforms are almost always at the center of broad and disbursed domestic refuse scatters.

Some workers' housing sites can be complex with multiple building locations, numerous refuse scatters and dumps, and ancillary features. If the site includes more than three residence locations, as well as aspects of infrastructure and an organization pattern, then the site probably qualifies as a mining camp. If a site has the characteristics of workers' housing but is labeled on historic maps as a mining camp, then it should be recognized as such.

Isolated Residence: Isolated residences are places of inhabitation not clearly tied to the mining industry or other forms of subsistence. Such resources would lack characteristics attributable to prospectors, miners, or other industry workers. Determining whether a resource is an isolated residence can be somewhat subjective since it may have served as base of operations for prospectors or miners who commuted elsewhere. Isolated residences are very simple and usually consist of a few residential features with no industrial or commercial attributes. Since the resource is not directly tied to a form of subsistence, occupation was usually brief and the volume of artifacts low.

Mining Camp: Mining camps were informal collections of residences, and they grew in response to several stimuli. One of the most common was the discovery of ore. Often, congregations of prospectors and miners established residences in a common area that offered flat ground and open space. Another stimulus was a primary industry that required a substantial workforce, such as a mill or a group of mines. Mining companies and individual workers erected residences near points of employment, usually in the most favorable building environment possible.

A form of unincorporated settlement, mining camps usually followed no formal organization, and their residences tended to be disbursed. When established by individual workers, the camps were truly haphazard in arrangement and appearance. If a company had a significant influence in a camp's founding, then some of the buildings may have shared a similar orientation, spacing, and size. Some settlements, such as Uranium, Long Park Camp, and Camoose Camp in Bull Canyon, drew enough population to justify a few services such as a post office, a school, and a mercantile.[9]

Because it was tacitly understood that the camps were temporary, the residents and mining companies invested little in architecture and infrastructure. During the 1900s and 1910s, a combination of wall tents, frame buildings, dugouts, and stone masonry cabins were the norm. The frame buildings tended to be poorly built and flimsy, and these and the tents were erected on informal foundations. By the 1950s, camps featured a combination of both stationary and portable buildings, and trailers of all sizes. When a camp was abandoned, nearly everything was dismantled for use elsewhere.

Most mining camps featured crude, unimproved infrastructures. The typical camp was usually center to a local road network in which main arteries provided links with the outside world, and access roads fanned out to area mines. All but the best-developed camps lacked running water and instead had to import the precious liquid in drums. Sanitation was limited to privies, although some of the camps with running water also featured primitive septic systems. By the 1930s, some settlements enjoyed electricity, which was wired from nearby mines or mills. At those without, the residents equipped their homes with propane stoves and refrigerators, and white gas lanterns. Root cellars were a common if not primitive form of food storage infrastructure. Camp residents used them to preserve perishable foods, and to store up to several weeks of provisions in the event that mud or snow made roads impassable.[10]

Workers' Housing and Mining Camp Feature Types

Animal Pen: In well-developed mining camps, families occasionally practiced subsistence and kept chickens, rabbits, and pigs for food. The families built primitive enclosures with salvaged materials for the animals.

Boardinghouse: A large residential structure often greater than 20 by 25 feet in area that was intended to house more than several workers. The residents may have shared sleeping quarters and usually consumed meals together, which were prepared in the building. Privies and domestic refuse dumps or scatters are usually associated with boardinghouses.

[9] Cotter, 2007; Moore, 2007.
[10] Davis, 2007; Holland, 2007.

Boardinghouse Platform: A platform where a boardinghouse stood. The platform may feature a root cellar and often represents the structure's size and footprint.

Boardinghouse Ruin: The structural remnants of a boardinghouse.

Bunkhouse: A residential structure where workers slept and spent leisure time, but did not regularly prepare food. Given this, bunkhouses often feature few food-related artifacts relative to the size of the building and the number of inhabitants.

Bunkhouse Platform: A platform where a bunkhouse stood. The platform should feature few food-related artifacts, and the platform usually represents the structure's size and footprint.

Bunkhouse Ruin: The structural remnants of a bunkhouse.

Cabin: A small residential structure, often less than 20 by 25 feet in area. Workers built some cabins of stone and others with lumber. Because cabins were often self-contained households, they usually offer a wide array of domestic artifacts. Privies are also often associated with cabins.

Cabin Ruin: The collapsed remains of a cabin.

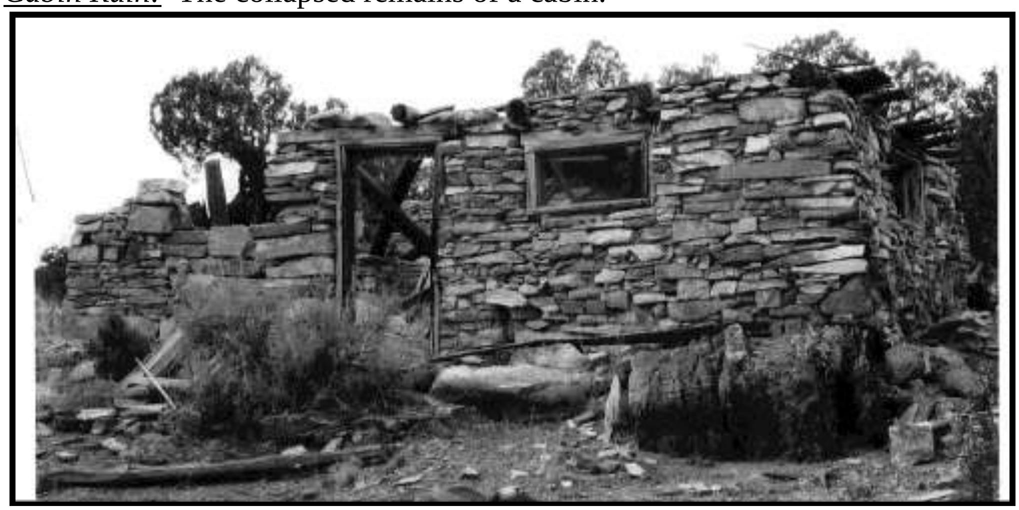


Figure F 5.2: Dry-laid stone was a common method for building cabins. Stone cabins that date to the 1950s should be considered for their cultural implications. Native American workers built this cabin at the Sunbeam Mine, and it loosely adheres to mid-twentieth century vernacular architectural styles found on Navajo reservations. Source: Author.

Figure F 5.3: Mining camps absolutely depended on water. Substantial camps often had cisterns for communal use, and this one at Bitter Creek Camp was a concrete vault buried to keep the water cool during summer. The fill port is a salvaged truck rim. Source: Author.

Cellar Pit: A pit excavated for storage, often surrounded by backdirt or a building foundation.

Cistern: Organized, well-capitalized residential complexes occasionally included cisterns for water. Cisterns were usually made of concrete or stone masonry.

Corral: Large residential complexes occupied between the 1900s and 1930s often included a corral. Corrals may feature formal and informal fences constructed from a variety of materials, and often utilize natural features.

Corral Remnant: Fences, fence remnants, linear rock piles, linear arrangements of stumps, and changes in vegetation often represent corrals.

Domestic Refuse Dump: A substantial concentration of domestic refuse, usually located downslope from a residential feature. Domestic refuse dumps consist primarily of food-related and other domestic artifacts including cans, fragmented bottles and tableware, and personal articles.

Domestic Refuse Scatter: A disbursed scatter of domestic refuse, usually located downslope from a residential feature.

Fire Hearth: Some camp residents cooked outdoors on stone hearths that were rectangular and several courses high. Hearths usually feature charcoal.

Firewood Cutting Station: A thick pile of wood chips, branches, and stumps where residents reduced logs into firewood. Many households depended on woodstoves for heat.

Figure F 5.4: In addition to the stone cabin above, Native American workers at the Sunbeam Mine built a hogan as a residence. They assembled the structure with logs and branches, and the siding has fallen away. Even when only partially intact, architectural features such as this are important for their cultural associations. Source: Author.

Figure F 5.5: Native American workers at the Rimrock Blues No.6 Mine built a traditional hogan as their residence. Refuse dating to the late 1950s surrounds the structure. Source: Author.

Hogan: Some Native American workers built hogans as residences. Hogans tend to consist of an inner frame, concentric rings of cribbed logs and branches around the outside, and an earthen covering. The top features a smoke port, and one side, often the east, has a doorway. Hogans are important for their cultural implications.

Hogan Frame: The frame that supported a hogan. If no eroded earth surrounds the frame, then the hogan's siding was exposed.

Hogan Ruin: The collapsed remnants of a hogan, which can manifest as a mound of earth with a depression at center. Aspects of the frame are often visible.

Privy: The structure that served as a toilet facility. Privy buildings were like those at mine sites.

Privy Pit: The pit underneath a privy. Privy pits often feature small piles of backdirt and may be surrounded by refuse. Privy pits are often less than 5 feet in diameter and may retain footers for the privy structure. Privy pits often contain important buried archaeological deposits.

Residential Building: A building, confirmed by artifacts, which served as a residence. Buildings may be classified as residential if they do not clearly possess the characteristics specific to boardinghouses, bunkhouses, or small cabins.

Residential Building Platform: A platform, confirmed by artifacts, to have supported an unspecified residential building.

Residential Building Ruin: The structural remnants of a residential building.

Road: Residential complexes usually required roads to accommodate traffic. Roads are at least 8 feet wide.

Figure F 5.6: The square rock alignment supported one of Long Park Camp's many frame residences. The foundation is typical of those at mining camps. Source: Author.

Root Cellar: Root cellars often manifest as dugouts located near residential buildings. They were independent structures used for food storage, and were usually made of rocks, logs, or lumber.

Root Cellar Ruin: The collapsed remnants of a root cellar.

Figure F 5.7: This root cellar at a mining camp on Davis Mesa is a typical storage structure. Large root cellars were often used by the entire community. Source: Author.

Stable: Mining companies often erected stables to house draft animals used for wagon drayage. Stables feature wide doorways, mangers, and stalls, and consisted of lumber or stone

Stable Ruin: A collapsed stable.

Sweat Lodge: Native American workers brought their cultural practices to the uranium mining environment and built sweat lodges for religious and health ceremonies. Sweat lodges are often concealed in trees away from residences for privacy. The structures are conical, around 6 feet in diameter and as high, and consist of layers of branches leaned together. The doorway is usually in the east side, and nearby are piles of cobbles that provided heat.

Sweat Lodge Ruin: The collapsed remnants of a sweat lodge.

Tank: Because water was scarce, most workers' housing and mining camps featured tanks for storage. Tanks were vertical or horizontal vessels of riveted or welded steel.

Tank Foundation: Large tanks required foundations, which usually consisted of timber bolsters or concrete and stone footers. Pipes may remain.

Tank Platform: Some tanks were free-standing and required no foundations, although they may have been placed on circular platforms. Pipes may remain.

Tent Platform: The tent platforms for workers' housing and mining camps are similar to those in prospectors' camps.

Trailer Pad: By the 1950s, large trailers were commonly used as residences. Workers usually parked them on bulldozed platforms and leveled them with rocks and timbers. Trailer pads are almost always center to refuse scatters.

Townsite: Uranium and vanadium mining played a fundamental role in shaping many towns in western Montrose and San Miguel counties. By the 1910s, when mining became a significant economic force, most of the towns had already been in existence for decades, although a few such as Uravan and Slick Rock were products exclusively of the uranium mining industry.

As a resource type, towns shared a few defining characteristics, regardless of size, timeframe, and exact location. Formal organization was one, and towns were often platted with lots and blocks laid out according to a grid. An identifiable commercial district was another characteristic, and the district's size and diversity were proportional to the town's population and demography. Small towns may have featured a few mercantiles, saloons, restaurants, and hotels, as well as individual assayers, laundries, blacksmiths, and liveries. As a town's population grew in numbers and sophistication, entrepreneurs established additional retail businesses such as a butcher, bakery, confectioner, shoe store, and combination stationary and book store. Professionals also offered their services, such as lawyers, dentists, barbers, tailors, and doctors. Although not heavily documented, women and families were an essential and present component of mining town demography, and they demanded institutions such as schools, churches, and public meeting halls.

The organization patterns of both small and large towns were similar. Business districts, however small, usually served as town centers, and they were surrounded by formal residences usually occupied by members of an upper socioeconomic status. In the region's early years, business proprietors often lived in their commercial buildings, which could have been one or two stories in height. Outlying residences tended to be scattered and haphazard in organization, and they were built in response to town growth.

Most of the towns possessed infrastructures in varying states of development. On a base level, most infrastructures catered to transportation, communication, and some forms of public utilities. Transportation infrastructures usually featured artery roads that accommodated regional freight and passenger traffic, and feeder roads that extended to the surrounding mesas. Placerville was the region's only link with railroads and was an important stop on the Denver & Rio Grande Southern. Streets and footpaths directed traffic within the towns, and even though many towns were arranged according to a grid, the roads and paths did not always conform.

The region's communication infrastructure was very primitive into the 1910s, and only the largest towns enjoyed postal service, newspapers, and telephones. By the 1910s, the telephone system was extended to many of the small towns as well, due primarily to the mining industry.

Water and sewer systems, and electricity, were additional forms of public utility limited to the large towns in the region's early years. In the large towns, service was not universal and instead was concentrated in the business districts and high socioeconomic status neighborhoods. This began to change during World War II, when uranium mining brought dramatic increases in population. In response to the growing demand for services, the AEC, USV, and VCA contributed funds to expand power, natural gas, water, and sewer in those communities these organizations had the most contact with. In particular, Nucla, Naturita, Uravan, and Gateway benefited the most, and the smaller communities may have enjoyed a few minor projects, as well.[11]

Townsite Feature Types

Townsites often include the same types of features described above with Workers' Housing and Mining Camps. A sampling of additional, prominent types of features is listed below. It should be noted that these generally apply to small and simple townsites, and the inhabited towns possess numerous additional archaeological and architectural features.

Assay Shop: An assay shop was a facility where a trained metallurgist tested ore samples for their mineral content. Assay shops usually featured stout workbenches, coal bins, a small furnace, and possibly a brick chimney.
Assay Shop Platform: A platform where an assay shop stood. Assay shop platforms may be identified by artifacts such as crucibles, cupels, fire clay fragments, laboratory ware, ore specimens, and bricks.
Commercial Building: Commercial buildings housed businesses and ranged in construction from small frame buildings to formal brick or cinderblock structures. Most commercial buildings featured an open floor, a back room, and a storage area.
Commercial Building Platform or Foundation: A platform on which a commercial building stood. Commercial building platforms may be identified by a substantial platform or foundation and associated privy pit with little evidence of actual residence, such as food-related items.
Ditch: Some towns featured ditches that delivered fresh water for consumption and other uses.
Gas Station: By the 1930s, most towns of substance featured a retail gasoline station. Between the 1910s and 1940s, rural stations often featured a frame office building and an island with several pumps. In some stations, an awning extended from the office out over the island. By the 1950s, stations featured a cinderblock building that had an office and at least one service bay, as well as a pump island, a paved parking area, and a prominent sign.
Gas Station Site: The location where a gas station stood. Foundations may represent the garage and pump island.
Hotel: A hotel was a temporary housing business and often featured a common room, an office, private quarters, and rented rooms. Small hotels tended to be

[11] *Colorado Mining Year Book* 1955 p101; *Colorado Mining Year Book* 1956 c.2 p42; *Colorado Mining Year Book* 1957 c.2 p43; Holland, 2007.

frame buildings with only several rooms while businesses in major towns may have been substantial and complimented by a dining and drinking establishment.

Hotel Platform or Foundation: A platform where a hotel stood. Hotel platforms tend to be large and may feature a cellar pit. Artifact assemblages usually include small personal items, food-related artifacts, furniture parts, and lamp parts and fragments. Hotel platforms may be difficult to distinguish from other residential structure platforms and may be identified through archival research. Large and numerous privy pits are often associated, and the quantity of ornate artifacts may be high.

Livery: A livery was an establishment where draft animals were temporarily boarded. Liveries may be defined by large stable ruins or platforms associated with broad corrals. Earth packed by animal traffic, manure deposits, collapsed fences, and artifacts such as tack straps and hardware can define a livery complex.

Mercantile: A mercantile was a retail establishment that ranged in construction from small frame buildings to formal brick or cinderblock buildings. Most mercantiles featured a sales floor, a back room, and a storage area.

Mercantile Platform or Foundation: A platform on which a mercantile stood. Mercantiles were primarily retail establishments often located in a moderate to large building. Based on this, mercantiles may be identified by a substantial platform or foundation and associated privy pit with little evidence of actual residence, such as food-related items.

Motel: Motels were intended to accommodate automobile travelers, and so the rented rooms were easily accessed from the outside. Motels constructed between the 1910s and 1940s often had an office, a utility shed, and detached cabins or duplexes with adjacent parking slots. Construction ranged from concrete to cinderblock to frame. By the 1950s, the typical design featured an elongated or L-shaped building for the rented rooms, a utility room, and the office. The grounds often featured landscaping, paved drives to control vehicle traffic, and prominent signs.

Restaurant: A restaurant was a dining business that ranged in construction from small frame buildings to formal brick or cinderblock buildings. Most restaurants featured a dining room, a kitchen, a storage area, and a root cellar. Work areas also usually existed behind the restaurant building.

Restaurant Platform or Foundation: A platform or foundation where a restaurant stood. Restaurant platforms are almost always denoted by large quantities of food cans, fragmented tableware and bottles, butchered bones, and kitchen implements.

Saloon: A saloon was a business that served primarily alcoholic beverages and possibly light dining fare. Most saloons ranged in construction from small frame buildings to formal brick or cinderblock buildings. They usually featured a bar room, a storage area, and a root cellar. By the 1930s, saloons were commonly referred to as bars.

Saloon Platform or Foundation: A platform where a saloon stood. High proportions of fragmented bottles relative to other types of artifacts often denote a saloon platform.

School: A school was an educational institution for children, and they were found almost exclusively in the established towns such as Uravan, Naturita, and Paradox. Through the 1930s, schools were large, utilitarian frame buildings surrounded by open space. New schools were part of the 1940s and 1950s community improvements, and they often were institutional in appearance, constructed of brick or cinderblock masonry, and had playgrounds. Most of these still exist.

F 5.2: Mining Settlement and Residence Significance

Because of its key role in the uranium mining industry, the Property Type of Settlement and Residence holds great significance. On a broad and fundamental level, settlements and residences were the very places of inhabitation for prospectors, workers, miners, and other participants of the uranium mining industry. The residences provided shelter and granted the inhabitants an environment where they could attend to the basic necessities of life. Both individual residences and settlements served as bases for cultural practices, leisure, socializing, communication, transactions between individuals, education, and other activities. In sum, settlements and residences were the support system for the people that constituted the mining industry. By providing for such needs, settlements and individual residences were a direct support system that allowed workers to elevate the uranium industry to a worldwide status. In addition to a broad significance, the individual Property Subtypes are associated with narrower arenas of significance, which are outlined below.

Prospectors' Camps: Because prospectors' camps were a direct manifestation of the prospecting movement, they are associated with many of the same basic trends as the Property Type of Prospects discussed in Section F 2.2. In broad overview, the main trends for resources dating between 1898 and 1922 include development of the uranium and vanadium mining industry, and the settlement of western Montrose and San Miguel counties. Resources that date between 1946 and the mid-1950s are associated with the growth of the uranium industry during the Cold War boom.

Prospectors' camps are allied with a few additional trends of importance specific to the resource type. The temporary encampments served as bases of operations for prospectors engaged in activities key to the discovery of carnotite and roscoelite ore deposits. Camps allowed prospectors to search for ore, characterize a region's geology, and conduct general exploration. When inhabited by groups of prospectors, camps served as meeting and communication centers where individuals exchanged information and news. Camps also served as primitive social centers for a segment of the mining industry that often went without human contact for long periods of time.

Prospectors' camps played important roles during three Periods of Significance, and these periods mirror the same timeframes as prospect resource types discussed at the beginning of the section. The first occurred between 1898 and 1905 (first Period), the second was between 1906 and 1922 (second Period), and the last happened between 1946 and the mid-1950s (fifth Period). Outside of these timeframes, sample drilling was the most important method of prospecting and largely rendered traditional prospecting obsolete (reviewed in Section E).

Workers' Housing and Mining Camps: Workers' housing and mining camps provided residential accommodations for miners and mill workers during the uranium industry's entire history. Because of this role, these two resource types are associated with many of the same trends Mines and Mills, discussed in Sections F 3.2 and F 4.2.

In broad overview, workers' housing and mining camp sites that date from 1898 to 1905 participated in the development of a reliable and important uranium mining industry in western Montrose and San Miguel counties. Between 1906 and 1922, the industry ascended from the position of world's second-most important to the main supplier of uranium, radium, and vanadium.

Workers' housing and mining camps occupied from 1935 to 1940 are associated with the Great Depression revival of vanadium mining in Montrose and San Miguel counties. During this time, the industry attained the status of the world's principal vanadium producer. The vanadium was an alloy material for steel used in numerous public works projects.

Between 1941 and 1945, workers' housing and mining camps are associated with trends that were critical during World War II. Montrose and San Miguel counties were the nation's most important source of vanadium, which was used to manufacture hardened steel weapons and armor. The region also was the principal domestic source of the uranium consumed by the Manhattan Project, which developed the world's first atomic bombs.

The workers' housing and mining camps that date from 1946 to 1963 are allied with the trends that were important during the Cold War uranium boom and nuclear arms race. Cold War uranium production and milling began in Montrose and San Miguel counties and continued into the early 1960s. During this time, the Atomic Energy Commission launched a number of programs to foster ore production and milling, and the programs revolutionized the region. The uranium industry also served as an important instrument in bringing Native Americans off their reservations and providing many their first encounters with industrial jobs.

The trends associated with nuclear power apply to workers' housing and mining camps that date from 1974 through 1980. The mining industry in Montrose and San Miguel counties was an important supplier of the uranium fuel required by powerplants.

Workers' housing and mining camps are associated with important trends in addition to those reviewed above. The first is economics, which can be divided into interactions within residences and outside. Residences, especially boardinghouses and bunkhouses, were microcosms of important economic activities. They were the sites of personal financial transactions such as the exchange of time and labor for pay, and the exchange of pay for room, board, and goods.

Cumulatively, workers' residences were an important component of regional, statewide, and national economic systems. The hundreds of workers employed by mining companies consumed food and other domestic goods purchased from a variety of sources. Preserved food was shipped from packing companies throughout the nation, while fresh foods came from Colorado farms and ranches. By consuming preserved and fresh foods, mining company employees not only supported a complex national food transportation network, but also farming and ranching in Colorado. Merchants in the major towns handled most of the food and goods, and the acquisition of such therefore contributed to local economies.

Social themes are another important arena of significance. Communal residences and entire camps were centers of communication between individuals, company officials, and the outside world. They were also the place of cultural practices, traditions, and diffusion, be the cultures Euro-American, Native American, or other ethnicities. Last, residences and camps were places where workers could attend to the necessities of life outside of the workplace. On a broad scale, workers' housing and camps sheltered much of the mining industry's workforce and saw it fed. Both workers' housing and camps also were direct manifestations of and instruments for permanent settlement in western Montrose and San Miguel counties.

Those workers' housing and mining camps inhabited by Native Americans are involved with both social and architectural trends of importance. During the 1950s, mining companies in the Southwest began employing Native Americans, primarily Navajos and Utes, in exchange for access to uranium ore on reservations. The Indians worked primarily underground and were quickly recognized as expert miners. Because of this reputation, companies in Montrose and San Miguel counties actively recruited Navajos, who ultimately constituted a significant proportion of the workforce. In so doing, the mining industry became an agent that brought large numbers of Indians off the reservations, provided them with training and employment, and placed them in an environment where they acculturated somewhat. The workers then improved the economies of their reservations when they returned with their earnings. Most Native American employees lived in workers' housing or mining camps to be near the mines. There, they engaged in traditional social, religious, and medical practices.

Those workers' housing complexes and mining camps inhabitated by Native Americans may be associated with architectural innovation. Specifically, some Native Americans adapted their traditional building practices to the uranium mining industry. When in need of residences, they constructed hogans, teepees, and stone cabins similar to those on reservations.

Isolated Residences: By definition, isolated residences cannot be directly attributed to an industry or other pattern of subsistence. For this reason, arenas of significance remain unknown until detailed studies or archaeological investigations of a given site provide clarifying information.

Townsites: Because these forms of settlement were complex and tied to numerous themes and systems, they are associated with important arenas of significance. Overall, they participated in many of the broad trends attributable to the uranium mining industry. These have been discussed in Section E, as well as Sections F 3.2 and 4.2.

The relationship between the towns and the mining industry is a fundamental arena of significance. The towns served as centers of communication, banking, supply, service, transportation, and meeting. Because of this, many mining companies and government agencies used the towns as their bases of operation. As supply points, the towns directly supported the mining outfits working in remote regions, and with this support, the outfits were able to generate most of the mining industry's ore. The towns also were centers of culture and community, and they moderated the social impact of a dominantly male mining workforce. The towns attracted families that demanded community services such as schools, cultural institutions, and medical clinics, which local governments then provided. Married miners forced to work at remote locations found that the towns provided them with an important social support network. Specifically, the miners were able to billet their families in the towns and live with them on weekends.

The theme of economics serves as another arena of significance for townsites. On one level, the townsites served as anchors and conduits for capital and investment. The presence of formal settlements lent legitimacy to the industry, which fostered confidence among potential investors. Further, these investors were more likely to personally examine a mining district if it was near an established settlement. In general, settlements were points through which capital flowed from investors to the mines and mills. This trend was particularly important during the 1900s and 1910s, when the mining industry was young and growing.

On another level, townsite residents consumed food and other domestic and commercial goods purchased from a variety of sources. Preserved food and other products were shipped from manufacturers throughout the nation, while fresh foods came from Colorado farms and ranches. By consuming such an array of goods, townsite residents not only participated in a complex national economy, but also supported Colorado farming and ranching.

Townsites were associated with social themes of significance. The settlements were important communication centers between residents, businesses, and mining interests in western Montrose and San Miguel counties, as well as with the outside world. Newspapers, telephones, libraries, community centers, drinking and dining establishments, and company offices all were outlets for information.

Townsites also were centers of both passive and active cultural practices and traditions. For passive practices, inhabitants followed their cultural patterns, traditions, and ways almost unconsciously in daily life. For active practices, inhabitants purposefully sought out cultural traditions such as performances, lectures, salons, organizations, and community events. Through these practices, settlement residents imprinted their culture on a surrounding region. The specific practices and traditions changed over time, but the overall pattern remained the same.

The townsites attracted a variety of individuals who did not work directly in mines or mills but were important to the development of the social fabric. They also provided support to the mining industry and its direct employees. Women, families, laborers, businessmen, and government administrators all contributed to a greater whole.

The theme of politics is another arena of significance that settlements share. On one level, settlements were active centers of the law enforcement and judicial systems that maintained order. On another level, the towns gave rise to administrative and regulatory bodies that oversaw local government activities, ordinances, claim registration and regulation, and records keeping. Settlements also served as polling stations, and, occasionally, as sources of candidates for local and county-wide political offices.

F 5.3: Mining Settlement and Residence Registration Requirements

Prospectors' Camps: Because prospectors' camps were ephemeral and occupied only briefly, many cannot be clearly identified today, and of those that are recognizable, relatively few can be expected to retain integrity. For this reason, most will be ineligible for the NRHP, although several exceptions exist. In general, eligible resources must possess physical integrity relative to the radium and vanadium boom of the 1900s and 1910s, or the first years of the Cold War uranium boom. During these timeframes, conventional prospecting played an important role in the discovery of carnotite and roscoelite ore bodies. By the late 1950s, however, conventional prospecting lost its significance to sample drilling. Because prospect camps possessed impermanent structures that were usually disassembled when the site was abandoned, the integrity will probably be archaeological. For archaeological remains to constitute integrity, the features and artifacts should represent the residence types, their locations, and aspects of the prospectors and their lifestyles.

Only a few of the seven aspects of historical integrity defined by the NRHP are likely to be relevant for prospectors' camps. The most applicable will probably be Setting, Feeling, and Association. The Setting around the camp must not have changed to a great degree from its Period of Significance, except for the removal of structures and equipment. Usually, this requires a preserved natural landscape and environment. In terms of Feeling, the site should convey the sense or perception of prospecting and residence from a historical perspective and from today's standpoint. For Association, the site's sum of features and artifacts should permit the researcher to reconstruct the prospect camp and aspects of the prospectors' lifestyles.

In addition to possessing integrity, prospectors' camps must meet at least one of the NRHP Criteria. By serving as bases of operations for prospectors, some camps may be associated with trends that are important in terms of Criterion A. Those sites that date to the 1900s and 1910s tend to be associated with the discovery of the region's carnotite and rosceolite ore formations, the development of a baseline knowledge regarding these ore types, and the establishment of uranium and vanadium mining in North America. These trends were significant on national levels. Those camps that date from the late

1940s through the mid-1950s are a product of the Cold War uranium boom. As such, they are associated with the event's beginnings, the widespread discovery of carnotite ore pockets and the continued relevance of conventional prospecting.

Prospectors' camps are unlikely to be eligible under Criterion B because it is extremely difficult to directly attribute a given site to an important person. In general, archival sources make almost no mention of prospectors' camps, and so little of the documentation necessary for Criterion B is available.

Prospectors' camps may be eligible under Criterion C under specific conditions. As noted, prospectors' camps consisted of impermanent structures that were almost always removed when the site was abandoned. As a result, nearly all sites remaining today are limited to archaeological features and artifacts, which is a sufficient level of integrity for eligibility under Criterion C. However, the archaeological remains must permit the virtual reconstruction of the camp, the types and locations of the residences, and aspects of the prospectors.

Prospectors' camps are unlikely to be eligible under Criterion D. Because the camps were usually occupied for brief periods of time, they usually lack meaningful, buried archaeological deposits capable of addressing research questions. Most information offered by camps can be obtained through qualitative recordation of surface features and artifacts.

Most prospectors' camps are unlikely to be eligible under Criterion G. Camps are directly associated with conventional prospecting, which played an important role only into the mid-1950s when rim deposits could still be found. By the 1960s, most of these had been discovered, leaving primarily deep deposits that required sample drilling.

Workers' Housing: It should be remembered that workers' housing resources can qualify as independent resources when they are isolated and cannot be attributed to a specific mine or mill. When they can be attributed, the workers' housing would be included with the mine or mill and its significance must be considered with that site. As independent resources, workers' housing sites are relatively common, lack important attributes, and tend to possess limited integrity. For this reason, most will be ineligible for the NRHP.

For workers' housing to be recommended eligible for the NRHP, it must possess physical integrity relative to the radium and vanadium boom (1898 to 1922), the 1930s revival (1935 to 1940), World War II (1941 to 1945), or the Cold War uranium boom (1946 to 1963). During these timeframes, workers' housing was important to the mining industry because of the daily support it offered. With that support, industry workers were able to achieve a high level of productivity. The level of integrity for workers' housing is expected to be archaeological because structures were usually removed when a site was abandoned. To be eligible, a site's features and artifacts should represent the residence types, their locations, and aspects of the workers and their lifestyles.

To be eligible under Criterion A, the researcher should tie workers' housing sites to the trends and events of a Period of Significance. Some of the trends discussed in Section F 5.2 apply, as well. Most workers' housing sites, however, are unlikely to be eligible under Criterion A because they are difficult to attribute to a specific mining or milling operation.

Workers' housing sites are unlikely to be eligible under Criterion B because it is extremely difficult to directly attribute them to important people. In general, archival sources make almost no mention of workers' housing, and so little of the documentation necessary to prove Criterion B is available.

As an independent resource type, most workers' housing will be ineligible under Criterion C. The reasons are that workers' housing sites are common, are difficult to attribute to a specific mine or mill, usually possess poor integrity, and offer no important attributes.

Several exceptions exist. First, sites that clearly date to the 1900s and 1910s are uncommon. The level of archaeological integrity must be high, and the features and artifacts must represent the types and locations of the residences and aspects of the workers. For integrity to be high, most of the features and artifacts should date to the 1900s or 1910s, and the site cannot have been heavily altered afterward.

Second, sites with standing buildings are uncommon and may be eligible because buildings are important representations of uranium industry workers' housing. The buildings should retain architectural integrity, which requires that the buildings feature their exterior appearance, materials, workmanship, and location. Major additions and alterations usually compromise architectural integrity.

Third, sites clearly attributable to Native American workers are important. Native Americans, mostly Navajos, constituted a substantial proportion of the uranium industry's miners, and they tended to live in workers' housing instead of the towns. A site must offer evidence of Native American occupation such as hogan and sweat lodge ruins or artifacts that reflect traditional materials use or cultural patterns.

Some workers' housing sites may be eligible under Criterion D if they possess buried archaeological deposits. Testing and excavation of the deposits may reveal information regarding the lifestyles, social structures, and demography of uranium industry workers. Studies of these arenas of research are important because they were not heavily documented in the past. Most information offered by workers' housing sites, however, can be obtained through qualitative recordation of surface features and artifacts.

Most workers' housing sites that are less than 50 years old are unlikely to be eligible under Criterion G because they are not important enough. However, they might be eligible if they were directly connected with a mill or group of mines that was important during the uranium industry's last two Periods of Significance. Miners and mill workers depended on the support of housing to contribute uranium to the nuclear weapons programs of the early 1960s and the nuclear power industry during the latter half of the 1970s.

Isolated Residences: Isolated residences are common and since they cannot be tied to a specific industry or means of subsistence, they lack significance. However, buried archaeological deposits may clarify which industry the residents were associated with. If this seems likely, the site may be eligible under Criterion D.

Mining Camp: Mining camps are important resources, and many hold the potential to be eligible for the NRHP. To recommend a camp eligible, it must possess archaeological integrity or better, date to one of the mining industry's Periods of Significance, and meet one of the NRHP Criteria. In general, camps that date only to the 1900s and 1910s radium and vanadium boom are rare and important, and camps occupied during the Cold War uranium boom are uncommon but not as rare.

To be eligible under Criterion A, a camp must be associated with the trends and events that were important during one of the uranium industry's Periods of Significance. During the Periods, mining camps were important to the uranium and vanadium mining industry because of the daily support they offered to workers and their families. With this support, industry workers were able to achieve a high level of productivity. The researcher may find that the trends discussed in Section E and Section F 5.2 apply.

Mining camps may be eligible under Criterion B if the researcher can prove the presence or influence of an important person. Archival sources rarely attribute people to mining camps, and so researchers will have difficultly proving the association of important people.

Some, but not all, mining camps will be eligible under Criterion C. For a camp to be eligible, its physical remains must retain integrity relative to one of the uranium industry's Periods of Significance. The level of integrity is expected to be archaeological because structures and aspects of infrastructure were usually dismantled when a camp was abandoned. To be eligible, a site's features and artifacts should represent both the camp's makeup and its residents. In terms of the camp, the individual buildings, the greater patterns of organization, and the infrastructure should be apparent. In terms of the residents, the artifact assemblage should convey demography, gender, diet, health, and levels of substance abuse. If a camp meets these requirements, then it can be considered a sound archaeological example.

If a camp possesses standing buildings, it may be eligible even if the archaeological integrity does not quite meet the above standards. The reason is that standing residences are rare and important representations of uranium industry workers' housing. The buildings should retain architectural integrity, which requires that their exterior appearances, materials, workmanship, and locations are original. Major additions and alterations usually compromise architectural integrity.

Camps inhabited by Native American workers are important. Native Americans, mostly Navajos, constituted a substantial proportion of the uranium industry's miners, and they tended to live on-site and return to their reservations on weekends. The site must offer evidence of Native American occupation such as hogan and sweat lodge ruins, or artifacts that reflect traditional materials use or cultural patterns. Such aspects are important attributes and represent an adaptation of Native American traditions and practices to the uranium mining industry.

Mining camps often hold a high potential for eligibility under Criterion D in several arenas. Building platforms and privy pits can feature buried archaeological deposits of importance. Testing and excavation of these may reveal information regarding the lifestyles, social structures, and demography of uranium industry workers. Studies of these arenas of research are important because they were not heavily documented in the past. Community organization is another arena of investigation. Qualitative site recordation may reveal patterns of the distribution of ethnicity, families, and socioeconomic status.

Most mining camps that are less than 50 years old are unlikely to be eligible under Criterion G because they are not important enough. However, they might be eligible if they were directly connected with a mill or group of mines that was important during the uranium industry's last two Periods of Significance. Miners and mill workers depended on the housing and social support offered by mining camps for their productivity, and this allowed them to contribute uranium to the nuclear weapons programs of the early 1960s and the nuclear power industry during the latter half of the 1970s.

Townsites: As a resource type, townsites directly associated with the uranium and vanadium industry are important on local, statewide, and national levels. Most townsites are still inhabited, if not viable entities, and they are expected to possess standing buildings and structures. All but Naturita, Nucla, and Norwood contracted significantly after the uranium industry went bust, leaving archaeological features and artifacts to represent their true sizes and content.

Townsites hold the potential to be eligible for the NRHP, although applying the Criteria is much more complicated than with the other types of uranium mining resources. Small and simple entities may be recorded as individual sites, while large townsites with numerous buildings may warrant division into historic districts. Architectural surveys are necessary to evaluate whether the townsite, or a group of buildings within, meets the necessary qualifications. To date, few projects involving architecture and community planning of uranium towns have been completed, and so no cohesive body of comparative data exists. As a result, only broad eligibility guidelines and generalities can be suggested below.

For a townsite to be recommended eligible, it must retain integrity relative to a specific timeframe. Townsites, however, are not restricted to the uranium industry's Periods of Significance, like most other types of resources. The reason is that the towns were important to the uranium industry during all its viable years, even between Periods of Significance. The only time in between Periods that the industry had almost no regional presence began in 1923 and ended around 1935. Otherwise, the towns provided direct support to the industry as centers of housing, communications, transportation, commerce, industrial services, social services, and banking.

The level of integrity is relative to a townsite's constitution. If a townsite possesses numerous standing buildings, then most of those buildings must retain the architectural characteristics of a specific timeframe. The reason is that such conformity conveys a feeling of and connection to the uranium mining era. If only a portion of a town meets the above requirement, then that portion should be considered alone, possibly as a historic district. Individual buildings may be eligible as contributing elements.

For those townsites that offer only handfuls of standing buildings, archaeological integrity must be considered. For archaeological remains to contribute to integrity, the material evidence should permit the virtual reconstruction of the locations and arrangements of buildings and infrastructure, and reflect aspects of the residents and their lifestyles.

Once the townsite's level of integrity has been determined, the researcher needs to apply the NRHP Criteria. To be eligible under Criterion A, a townsite or its constituent elements must be associated with important trends and events. Section E outlines those specific to the uranium industry's Periods of Significance, and Section F 5.2 discusses a few additional trends.

Entire townsites, individual buildings, or complexes within may be eligible under Criterion B if the researcher can prove the presence or influence of important people. The resource must retain integrity, if only on an archaeological level, relative to the important person's timeframe. It should be noted that the general inhabitation of a settlement by an important person is too indirect an association for the Criterion. The individual's specific place of occupation must be identified, or the person must have played a fundamental role in the settlement's physical development.

Some, but not all, townsites will be eligible under Criterion C. To be eligible in entirety, the townsite should possess assemblages of archaeological, architectural or engineering features and artifacts that clearly convey aspects of the community. Examples include the settlement's organization and infrastructure; the arrangement of residences and businesses; the distribution of socioeconomic status, gender, and ethnicity; and details of lifestyle such as diet, health, substance abuse, and consumerism. Of note, many of these aspects can be charted through a careful study of artifacts and architectural characteristics. To be eligible, the resource should date to a specific timeframe. If a townsite meets these requirements, it can be considered a sound example.

Standing buildings within a townsite may be eligible on an individual basis. They must retain integrity relative to a specific timeframe. Integrity requires defining architectural characteristics and original appearance, materials, workmanship, and location. Major additions and alterations usually compromise architectural integrity. Buildings that meet these qualifications are uncommon and may be important representations of uranium mining-era architecture.

Townsites hold a high potential for eligibility under Criterion D in several arenas. The first is traditional archaeological studies. Buildings, cellar pits, building platforms, refuse dumps, and privy pits often feature buried archaeological deposits of importance. Testing and excavation of these may reveal information regarding the lifestyles, social structures, and demography of uranium industry participants. Studies of these research topics are important because they were not heavily documented in the past.

Another arena of investigation includes community organization, development, and demography. If archaeological features dominate the townsite, then qualitative recordation and artifact analysis may reveal patterns of organization, stages of development, and the distribution of ethnicity, families, and socioeconomic status. For those townsites with standing buildings, similar conclusions can be reached through architectural surveys and ethnographic studies of residents with living memory of the uranium industry.

Townsites that are less than 50 years old may be eligible under Criterion G because they provided many forms of support to the uranium mining industry. The uranium industry depended on the towns and their residents for viability and, with support, contributed heavily to the nuclear weapons programs of the early 1960s and the nuclear power industry during the 1970s. For a townsite to eligible under Criterion G, it must retain architectural or archaeological integrity relative to the 1960s or 1970s.

F 6: PROPERTY TYPE: RURAL HISTORIC LANDSCAPE

F 6.1: Definition of Rural Historic Landscape

As a resource type, Rural Historical Landscapes are often overlooked because of their unconventionality, sizes, perceived complexities, and misunderstandings regarding content and integrity. Landscapes can be recorded and evaluated in terms of the NRHP like other types of resources, and the same general requirements for eligibility apply. Western Montrose and San Miguel counties possess numerous areas that have the potential for designation as Rural Historic Landscapes. For its Historical American Landscape Survey program, the National Park Service defined in detail a Rural Historic Landscape. In overview:

> "A rural historic landscape is defined as a geographical area that historically has been used by people, or shaped or modified by human activity, occupancy, or intervention, and that possesses a significant concentration, linkage, or continuity of areas of land use, vegetation, buildings and structures, roads and waterways, and natural features."[12]

Concise areas in western Montrose and San Miguel counties that experienced uranium mining certainly fit the definition. Groups of individual resources such as mines, millsites, and mining camps will constitute most uranium mining landscapes. The specific type of uranium mining landscape will then be defined by the dominant or most numerous resources.

F 6.2: Rural Historic Landscape Significance

In general, Rural Historic Landscapes are important as large-scale representations of the uranium mining industry. They can be evocative of mineral exploration, the cultural geography of uranium mining, Atomic Energy Commission and Cold War policies, environmental impacts, and other broad aspects. The significance of a specific landscape will be defined by its dominant resource types. For example, if a landscape consists mostly of Cold War era mines, then the

[12] McClelland, et al., 1999:1.

aspects of significance relevant to Cold War mining will apply. For arenas of significance, the researcher should review Section E, and Sections F 2.2, 3.2, 4.2, and 5.2.

F 6.2: Rural Historic Landscape Registration Requirements

In terms of uranium mining, a Rural Historic Landscape should impart the feeling and represent aspects and impacts of the uranium industry. To do so, a landscape should combine an assemblage of individual historic resources with an intact natural setting. The types of individual resources can include prospects, mines, millsites, buildings, structures, and settlements. Bulldozed areas and roads are another form of resource that are overlooked hallmarks of the uranium mining industry. From the 1940s through the 1970s, hundreds of miles of roads were bulldozed throughout the region to access mines and drilling areas. On the mesas, innumerable pads and swaths were also bulldozed in preparation for sample drilling. While the bulldozing might not seem aesthetically pleasing today, it is absolutely characteristic of uranium mining industry landscapes. A similar case can be made for highways and power lines.

For a Rural Historic Landscape to be eligible, it must retain physical integrity relative to one of the uranium industry's Periods of Significance. This requires that most of the constituent resources retain integrity on an individual basis and date to a common time period. The integrity can be archaeological in nature. Most of the individual sites should present some visual impact, although the impact of some may be limited to an immediate and subtle level. If the individual resources meet these qualifications, then they are contributing elements of the landscape. Most of the individual resources in a landscape must be contributing elements, and they should collectively constitute an intact historic fabric. The researcher must clearly demonstrate that most of the sites comprising a landscape are contributing elements. The most defensible strategy to achieve this is to record and evaluate all the sites on an individual basis, and then discuss the results in terms of the landscape.

Modern intrusions can impact the integrity of a landscape. Most landscapes feature some level of modern disturbance and few will appear exactly as they existed in the past. However, the intrusions should not detract significantly from the landscape's ability to convey a sense of the uranium industry.

For a Rural Historic Landscape to be eligible, it must not only possess integrity and date to a Period of Significance, but also fulfill one of the NRHP Criteria. If a landscape and its contributing elements date to one of the uranium industry's Periods of Significance, the landscape will be associated with the same trends and events that define the Period as important. In this case, the landscape can be eligible under Criterion A. The researcher must identify which aspects of the uranium industry the landscape represents, specify the Period of Significance, and then relate the landscape to the Period's important events. For example, if a landscape consists of rim mines developed during the 1910s radium and vanadium boom, then that landscape represents ore production during the boom. In this context, the landscape is tied to and a product of those important trends associated with uranium mining during the 1910s boom.

Relatively few landscapes will be eligible under Criterion B because of their scale. For an entire landscape to be eligible, an important person must have played a direct role in its planning and organization, or spent an appreciable amount of time throughout the terrain. Most large-scale landscapes were not planned or designed, and instead were collections of resources such as mines. Some small-scale landscapes such as townsites and mill sites are exceptions because they were formally planned. If an individual site within the broader landscape hosted an important person, then that site alone will be eligible under the Criterion and should be evaluated for its significance separately.

Landscapes hold a high potential to be eligible under Criterion C. The researcher must determine what aspects of the uranium mining industry the landscape represents. Common themes include prospecting, mining, milling, and settlement in any combination. Most of the constituent sites should retain integrity at least on an archaeological level and date to a common timeframe, and modern intrusions should either be minimal or compatible with the historic land use. The researcher must discuss how the landscape's characteristics and contributing elements represent the identified aspects of the uranium mining industry.

A landscape may be eligible under Criterion C if it was the work of a master planner, engineer, geologist, architect, or other uranium industry official. This usually applies to small-scale, engineered landscapes such as mills, infrastructures, and settlements. The researcher must identify who the individual was and discuss their impact on the landscape.

Some landscapes may be eligible under Criterion D if they hold a high potential to contribute meaningful information. The arenas of inquiry should rely on the information offered by the landscape as an entity rather than only a few of its individual sites. For example, the excavation of buried deposits disbursed throughout a settlement can reveal broad patterns of community organization, development, and demography. Groups of mines may feature connected underground workings that can contribute to the understanding of broad-scale mine engineering, planning, and operations. Studies of a millsite and its infrastructure may enhance our knowledge of the support systems required for ore concentration.

Landscapes whose contributing elements are less than 50 years old can be eligible under Criterion G. For a landscape to be eligible, most of the contributing elements must not only be less than 50 years old, but also they must date to one of the uranium industry's last two Periods of Significance. In total, the landscape must have played an important role during one of the two Periods, and in so doing, the landscape will be associated with the trends that define the Periods as important. The most important trends are contributions to the nation's military nuclear capabilities during the Cold War and to the nation's nuclear power generation capabilities during the 1970s.

SECTION G: GEOGRAPHICAL DATA

The geographical area covered by the Guide to Assessing Historic Radium, Uranium, and Vanadium Mining Resources in Montrose and San Miguel Counties Multiple Property Documentation Form consists of the western portions of Montrose and San Miguel counties. The area of carnotite mining extends west from Naturita, and the area of roscoelite mining immediately surrounds Placerville.

SECTION H: IDENTIFICATION AND EVALUATION METHODS

Mountain States Historical employed a multiphase research methodology to provide an accurate account of the region's important mining history and understanding of its resources. The first phase involved intensive research at six important archival facilities in the Denver area. The institutions in order of relevance are the Colorado School of Mines, Denver Public Library Western History Collection, the University of Colorado at Boulder library system, Colorado State Archives, the Colorado Historical Society's Stephen S. Hart Library, and Boulder Public Library's Carnegie Branch.

Key events, trends, organizations, and people of the region's mining history were determined from a wide variety of materials. The most important were historic publications, historic periodicals, mine inspectors' and engineers' reports, maps, popular literature, manuscript collections, and other archival materials. All are listed in the bibliography.

The second phase of the methodology was ethnographic research among participants in the uranium mining industry. A total of ten men and women in the Naturita were questioned regarding communities, mining methods, technology, residence at the mines, and other aspects of life between the 1940s and 1980s. The interviews provided information unavailable in traditional archival sources.

For the third phase of the methodology, Mountain States Historical relied on the results of fieldwork completed for this and other projects. A total of 65 mining resources was recorded and evaluated for the MPDF project, and the findings published in a separate report designed to provide qualitative data. Eric Twitty inventoried an additional 23 mining resources in 2005 and included a qualitative research design in report of the findings, which provided additional information. Jon Horn of Alpine Archaeological Consultants recorded six uranium mining resources in 2002 and 2003, and provided detailed data. Calamity Camp, an important mining settlement in Mesa County, was among Horn's sites, and his data proved highly useful. Overall, the body of information from the recorded sites was important because it provided material evidence that filled data gaps inherent in archival sources. The material evidence proved essential for defining resource types, their rarity, applications of technologies, mining methods, settlement, and timeframes.

Two approaches were useful for identifying the Periods of Significance for the region's uranium mining history. One was consulting the archival materials listed in the bibliography, and the other was a statistical analysis of population and the numbers of prospects, mines, and mills that were active between 1898 and 1980. To improve accuracy, these resources were tabulated for their frequency in five-year increments, and mines were divided among operations of small, medium, and large scale. Susanne Schulz's Colorado census compilation entitled *A Century of the Colorado Census* provided population figures.

Such statistical analysis methods have inherent weaknesses but are well-equipped to identify Periods of Significance. For example, sudden rises in both population and the numbers of prospects can be interpreted as a period of discovery, mineral exploration, and boom. Gradual population growth combined with an increase in small- and medium-sized mines often reflects the early phase of a productive mining industry, and a slight contraction in population coupled with a decrease in small mines and an increase in large operations suggests the maturation of mining. In terms of weaknesses, the statistical analysis relies on the accuracy of the archival resources. Some of the five year increments were poorly covered, and some important mines were not mentioned or reported, even though they were active at times. In addition, it seems likely that many prospects were not reported because of their unimportance at the time.

Ordinarily, production figures are important indicators of the phases that a mining industry experienced. Archival sources such as Charles Henderson's *Mining in Colorado* and the *Minerals Yearbook* divide production among specific metals, which, in western Montrose and San Miguel counties, were primarily radium, uranium, and vanadium. But one principal factor rendered production figures unreliable. Specifically, because uranium was a strategic metal for nuclear weapons, its production figures were left out of archival sources during the 1940s and 1950s. This seems surprising given the importance of the uranium mining industry at this time and the propensity for government records-keeping. Secrecy for national security reasons explains the vagueness of existing records, as can be inferred from the *Minerals Yearbook*, which was one of the most prominent and reliable annual mining summaries published by the Federal Government. The following statement appeared in several issues:[13]

> "Cognizance of the military and industrial power derivable from nuclear energy prompted an intensive global hunt in 1946 for uranium and thorium ores. Quantities found, mined, exported, or refined were kept secret by all nations for security reasons, and thus no measure of current or potential supply is obtainable."

[13] *Minerals Yearbook*, 1946:1205.

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